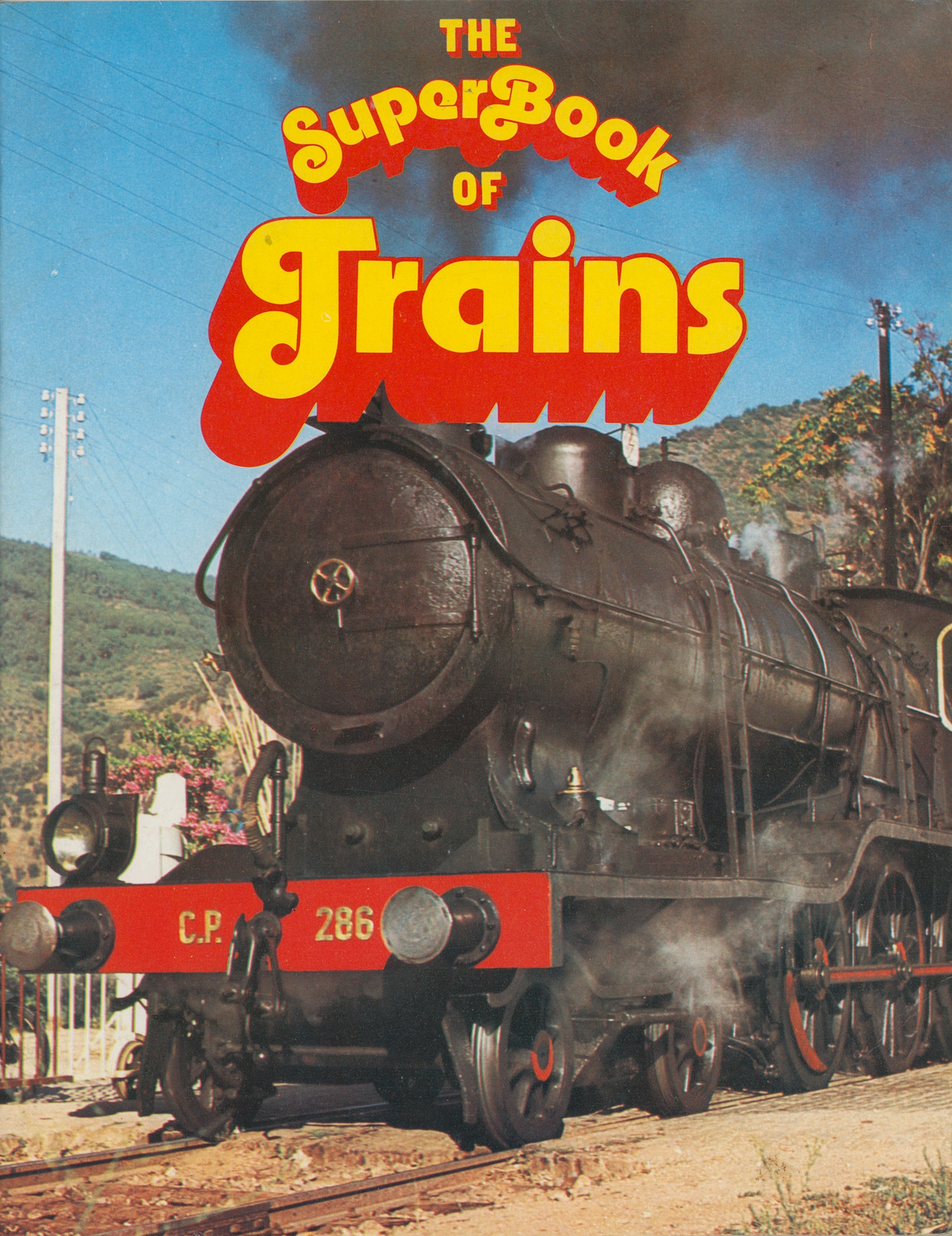
THE SuperBook OF Trains



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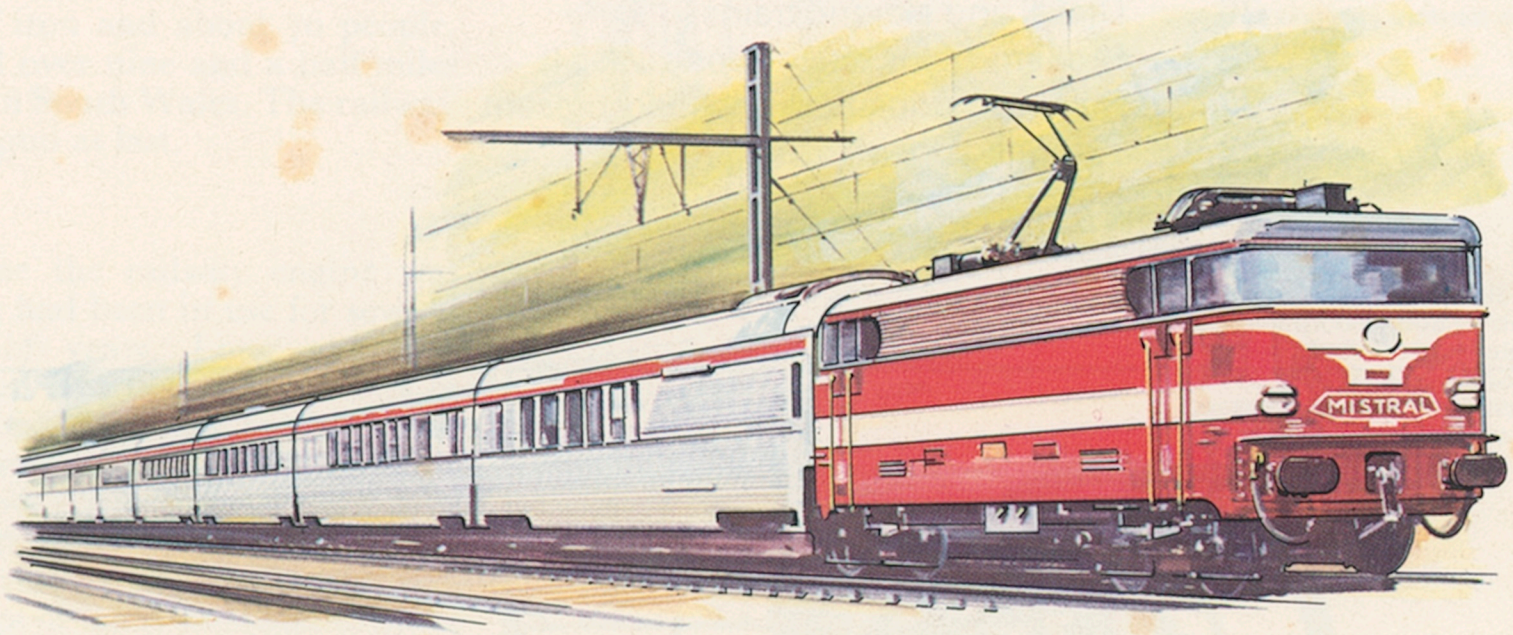

Macdonald

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Steam pioneers

Early engines

Railways of a kind are far older than steam power. And by the late 18th century, Britain—the country which had pioneered the "industrial revolution"—had quite a large mileage of horse-worked "tramways".

However, the first steam engines were not built to pull trains. It was coal-mining that led to the invention of the steam engine. More coal was needed for use in industry, but the deep mines often flooded and could not be worked. Then in 1712 Newcomen, an Englishman, produced a steam pump which was used to keep the mines dry.

James Watt, a Scotsman, built more powerful engines from the 1770's. They were used to drive factory machinery and worked on a better principle, but were much too cumbersome to be useful for locomotion.

The first railway engine

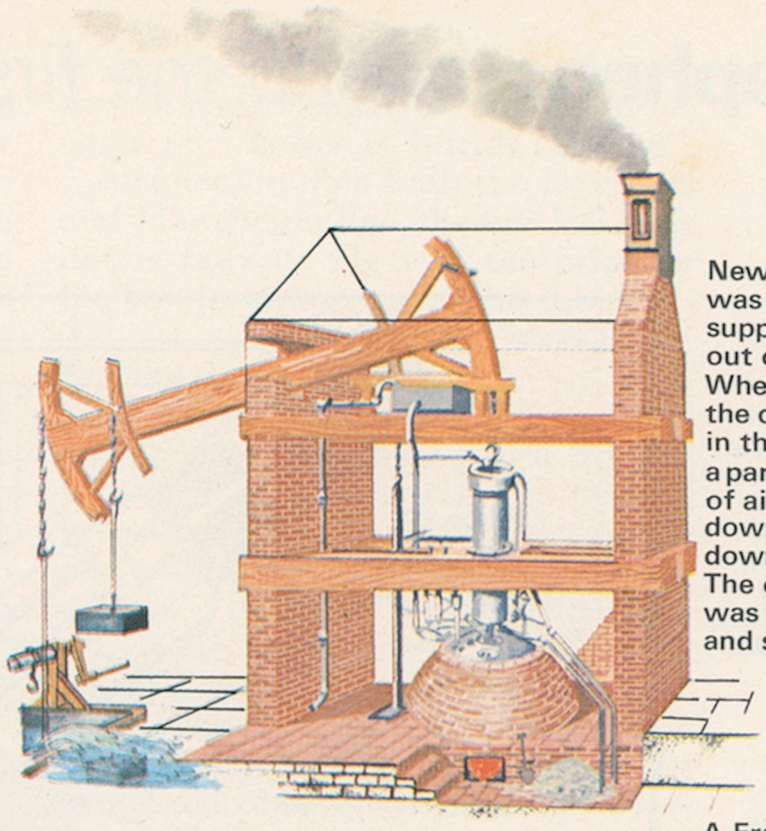
It was not until the nineteenth century that a steam engine was made to go on the road. Cugnot, a Frenchman, had made a steam tractor in 1769, but it was not a great success. Then in England in 1801 Richard Trevithick made a steam engine that worked much better.

Finally, three years later, Trevithick built the first railway engine. This engine pulled the first self-propelled train in the world. The train carried ten tons of iron and about 70 people. It travelled over nine and a half miles of railway in South Wales. The railway age had begun at last.

Rails

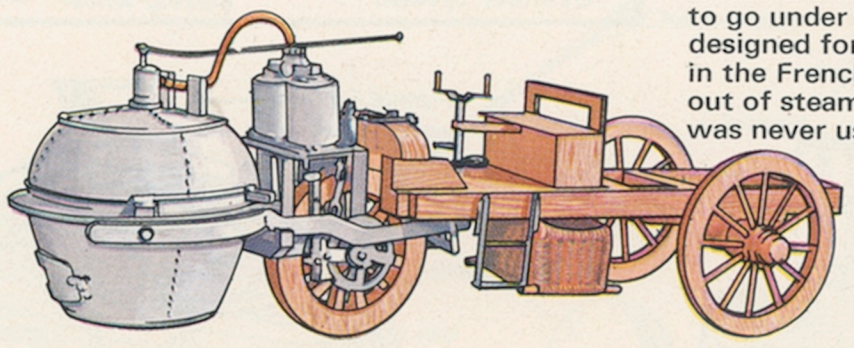
By the time the railway engine was made, rails had been in use for several hundreds of years. Long ago, the Romans had laid two parallel lines of paving slabs along their roads for the chariot wheels to run on.

In the 16th century, the wagons used in mining districts to carry coal needed a smooth surface to run on. At first, simple strips of wood were laid to guide their wheels; but timber did not last well, and so it came to be faced with metal plates. All-iron rails followed, with various shapes being tried and even cog-wheels being experimented with before the present-day form was devised, over 150 years ago.



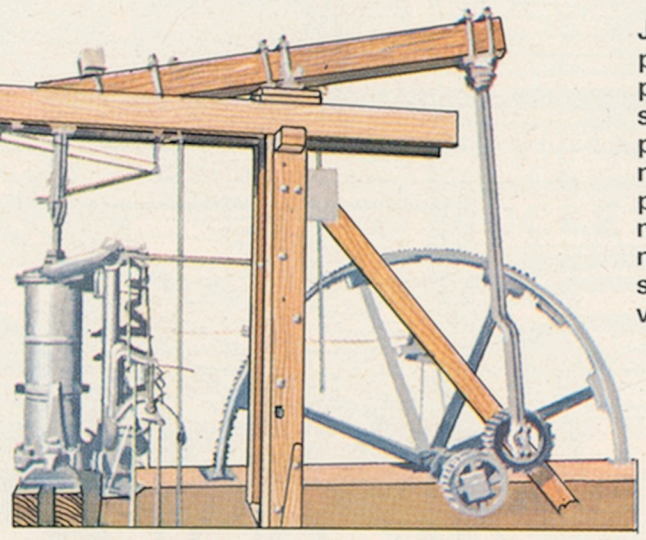
Newcomen's steam pump 1712

Newcomen's steam pump (left) was used to pump city water supplies and for pumping water out of flooded coal mines. When the piston was at the top of the open cylinder, steam condensed in the space underneath. This made a partial vacuum so that the pressure of air on top of the piston pushed it down. As it went down it pulled down one end of a rocking beam. The other end of the beam, which was connected to a pump, went up and so lifted the water.



Cugnot's steam tractor 1769

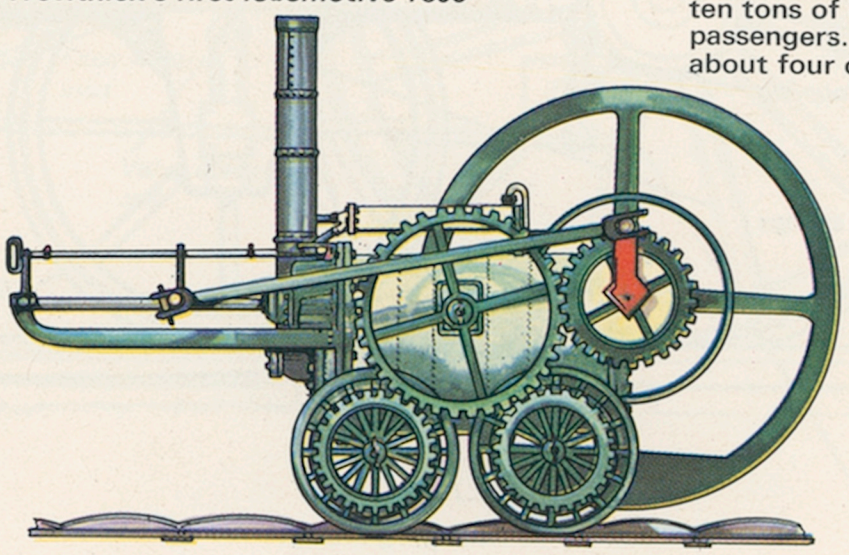
A Frenchman, Cugnot, built a steam tractor (left) in Paris in 1769. It was the first vehicle in the world to go under its own power. It was designed for pulling field guns in the French army. The tractor ran out of steam very quickly, so it was never used in battle.



Watt's steam engine 1775

James Watt changed the whole process of the steam engine. He produced a cylinder in which steam pressure, and not air pressure, drove the piston. This made his engines faster and more powerful. Then he used them to make wheels turn. Factory machinery could now be driven by steam engines instead of by water mills.

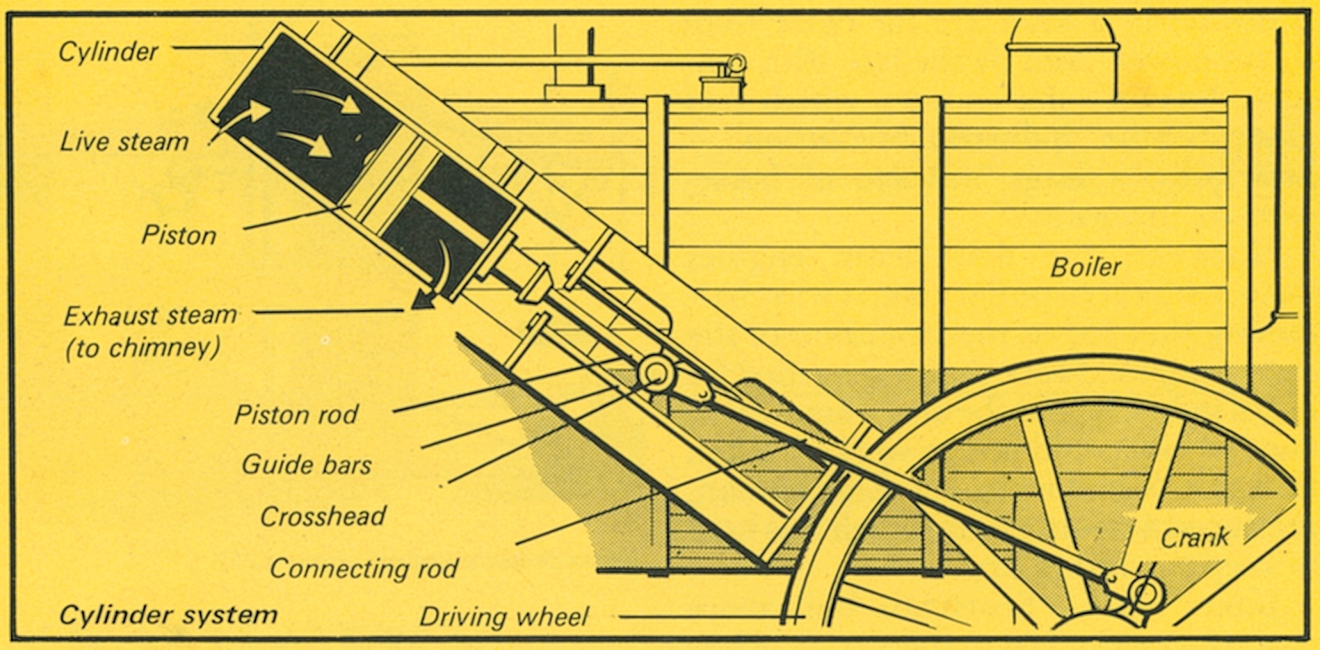
Trevithick's first locomotive 1803



Richard Trevithick built the first railway locomotive in the world (below). In 1804 his train carried ten tons of iron and about 70 passengers. The train travelled at about four or five miles an hour.

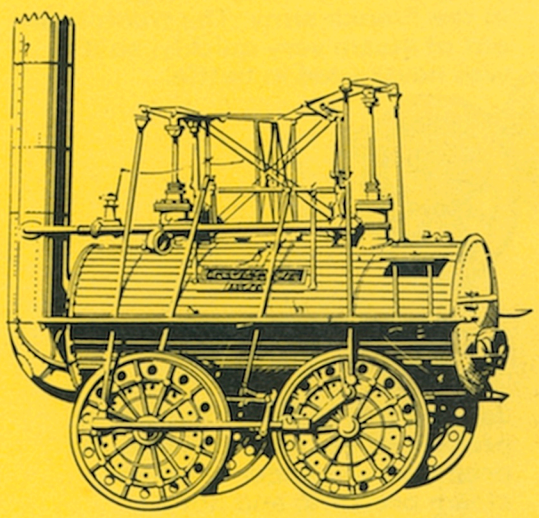
George Stephenson and the first railways

The driving system of George Stephenson's *Rocket* (right). Flames and gases from the fire passed along tubes through the water in the boiler to produce steam. The steam, controlled by a valve, went to the cylinders. Steam on top of the pistons drove them down, and steam below pushed them up again. The up and down movement of the pistons drove connecting rods and cranks, which made the driving wheels go round.

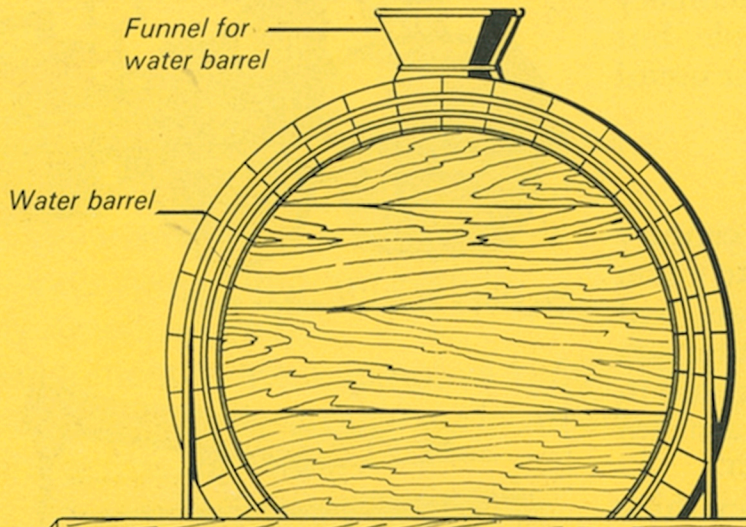


Cylinder system

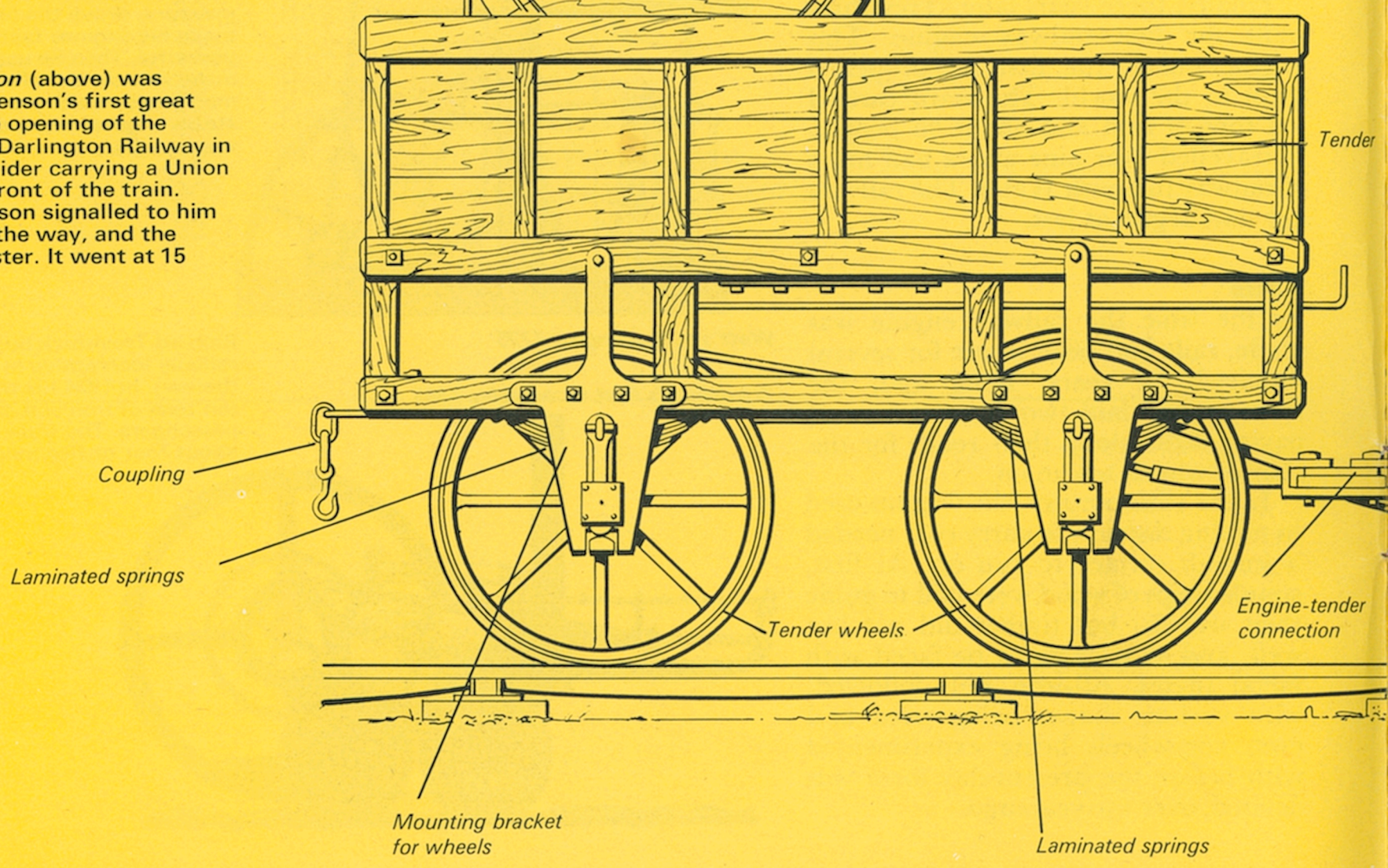
Locomotion 1825



The *Locomotion* (above) was George Stephenson's first great engine. At the opening of the Stockton and Darlington Railway in 1825 a horse-rider carrying a Union Jack rode in front of the train. Then Stephenson signalled to him to get out of the way, and the train went faster. It went at 15 to 20 m.p.h.



Stephenson's *Rocket* (above and below), which triumphed at some famous trials held before the opening of the Liverpool and Manchester railway in 1830, had a number of improvements over his *Locomotion*.
Note the simpler driving-gear made possible by moving the cylinders towards a more horizontal position. This change also helped the engine to run more smoothly.



Industrial railways

When Trevithick made his first steam locomotive, England was in the middle of the industrial revolution. Better transport was needed, particularly in the coal and cotton industries. Road transport was slow, and the canal system was also inadequate. Steam-powered railways solved the problem.

One group of mine-owners wanted to build a railway to take coal from Darlington to Stockton. At first, the trains were to be horse-drawn. Then an engineer called George Stephenson persuaded the company to give him some money to build a locomotive.

The first public railway

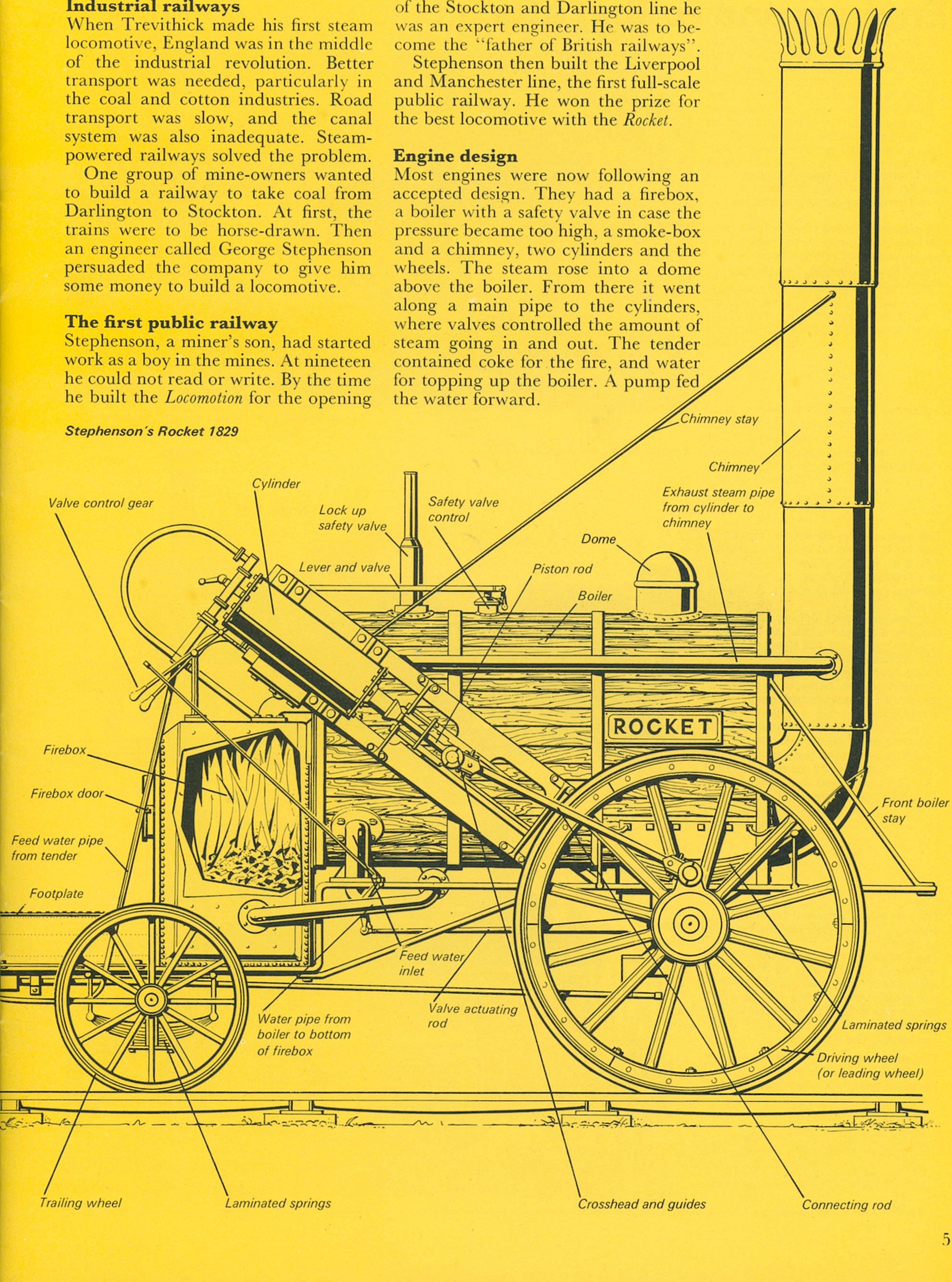
Stephenson, a miner's son, had started work as a boy in the mines. At nineteen he could not read or write. By the time he built the *Locomotion* for the opening of the Stockton and Darlington line he was an expert engineer. He was to become the "father of British railways".

Stephenson then built the Liverpool and Manchester line, the first full-scale public railway. He won the prize for the best locomotive with the *Rocket*.

Engine design

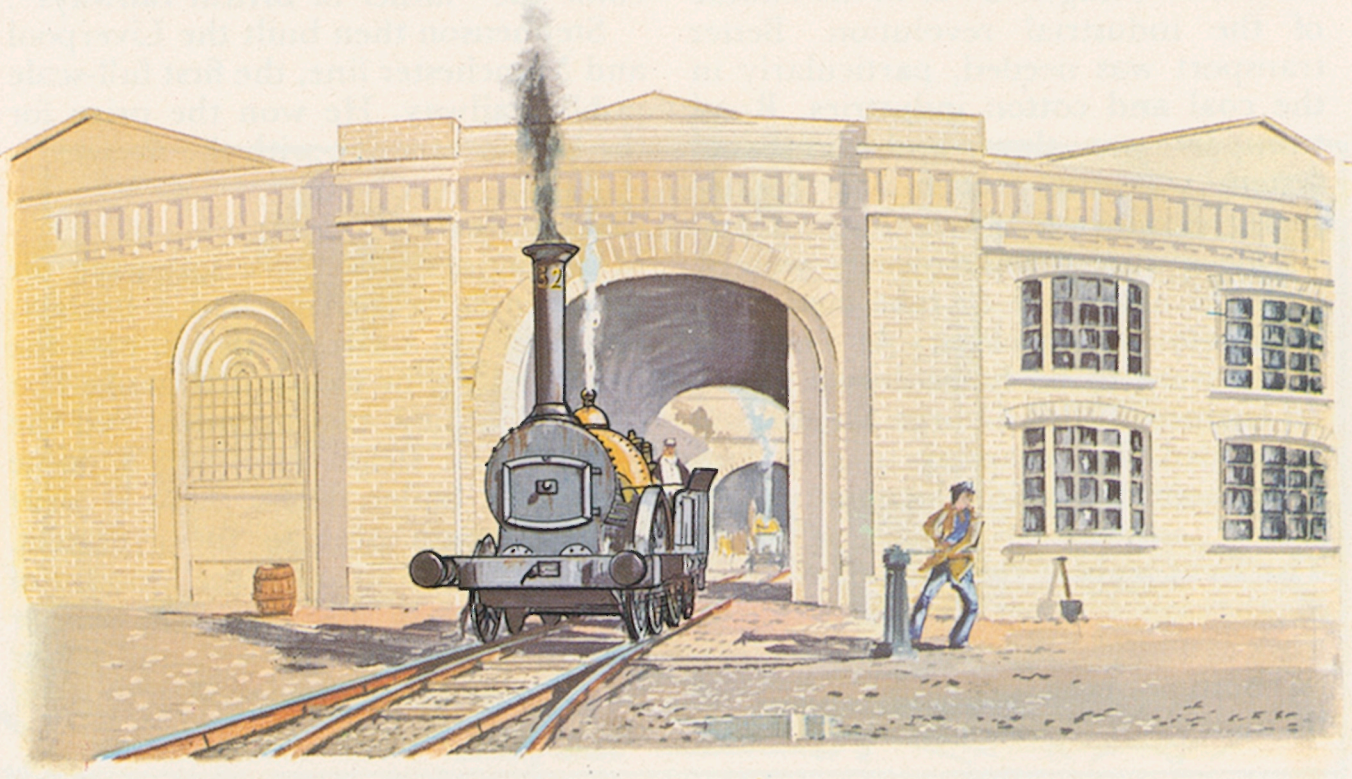
Most engines were now following an accepted design. They had a firebox, a boiler with a safety valve in case the pressure became too high, a smoke-box and a chimney, two cylinders and the wheels. The steam rose into a dome above the boiler. From there it went along a main pipe to the cylinders, where valves controlled the amount of steam going in and out. The tender contained coke for the fire, and water for topping up the boiler. A pump fed the water forward.

Stephenson's Rocket 1829



Engines and rolling stock before 1850

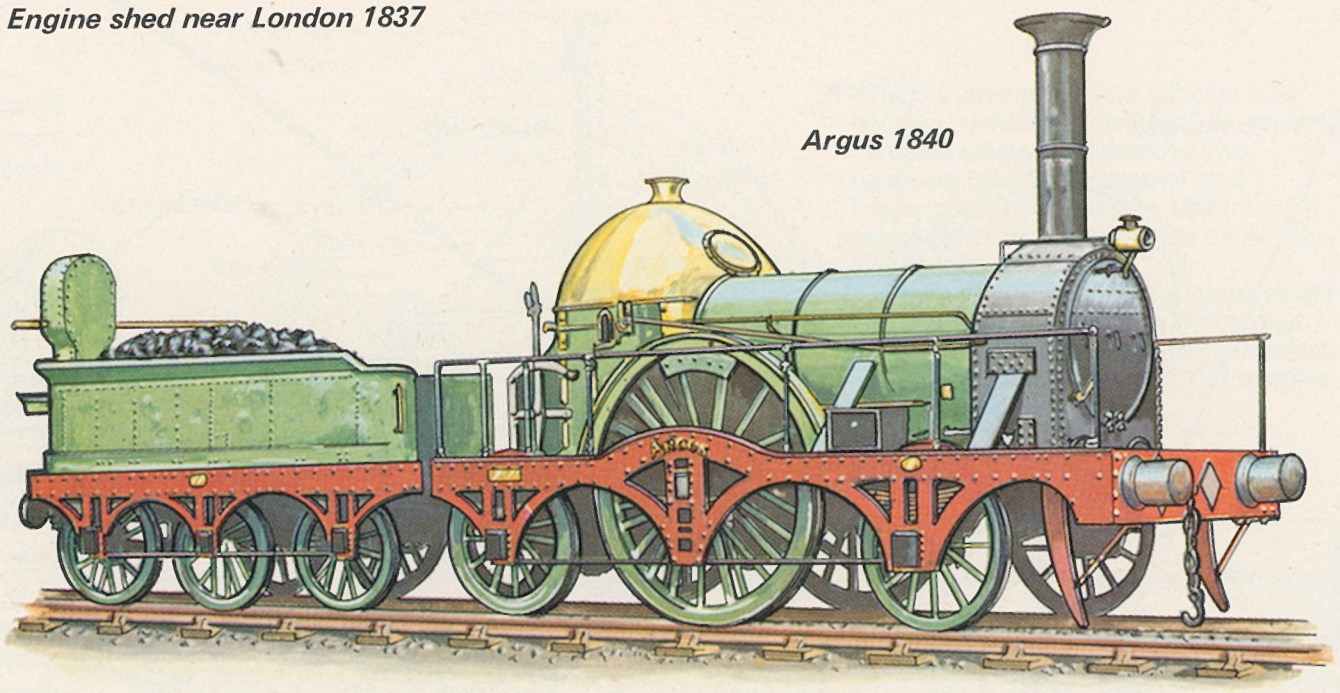
The London to Birmingham line was finished in 1838. It linked up with the Grand Junction, opened in 1837.
The circular engine shed (right) on the line into London was called the roundhouse: it has now been turned into a theatre. The picture shows a pointsman at work.



Engine shed near London 1837

The express engine *Argus* (right) was built to run on rails that were 7 ft. $\frac{1}{4}$ in. apart, known as the broad gauge. Stephenson had wanted to set all rails 4 ft. $8\frac{1}{2}$ in. apart.
But another great British engineer, Isambard Kingdom Brunel, laid his London to Bristol (or Great Western) line on the broad gauge. This had some advantages, but prevented through traffic. Later, a standard-gauge rail was added to the broad gauge.

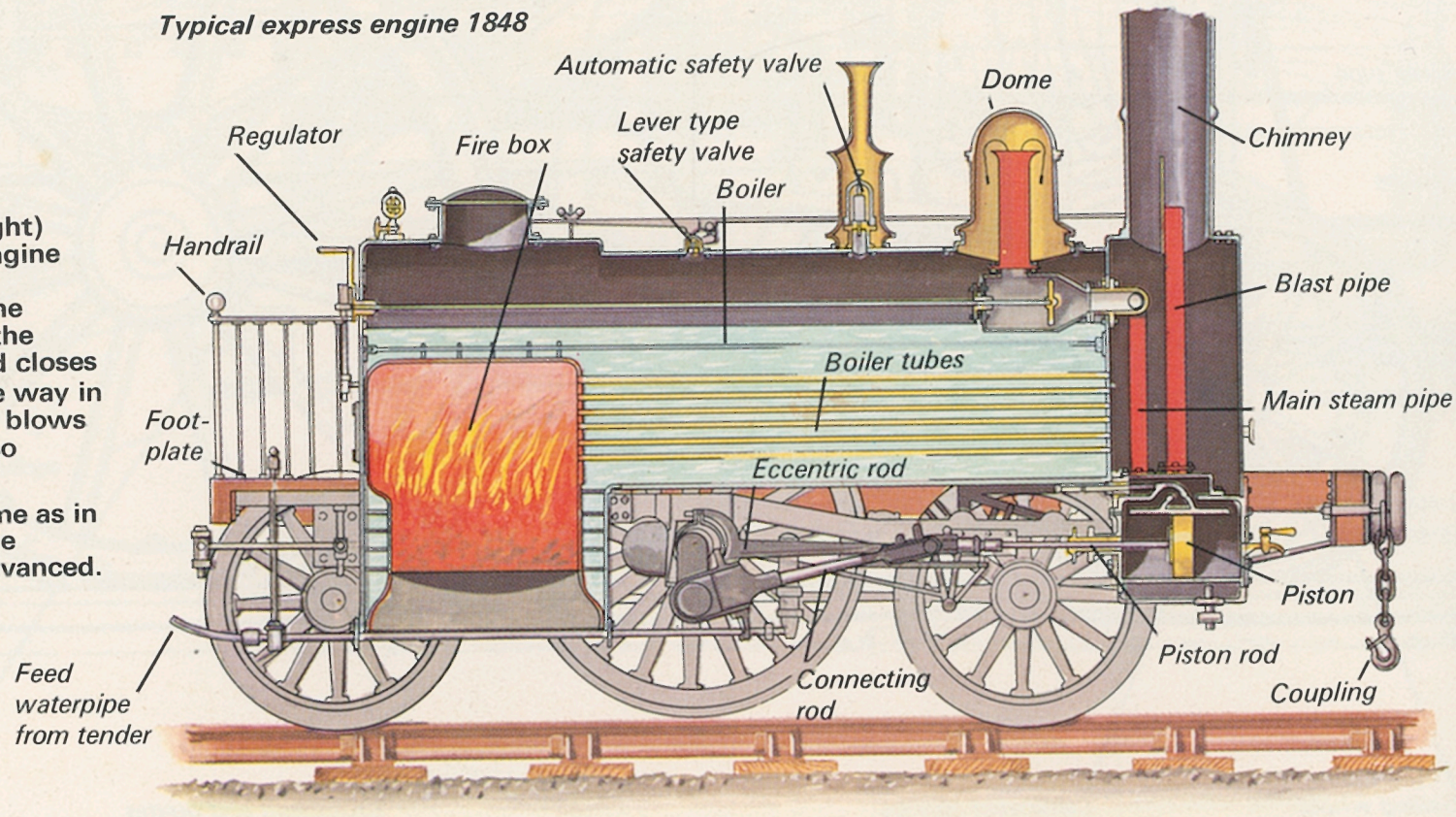
Argus 1840

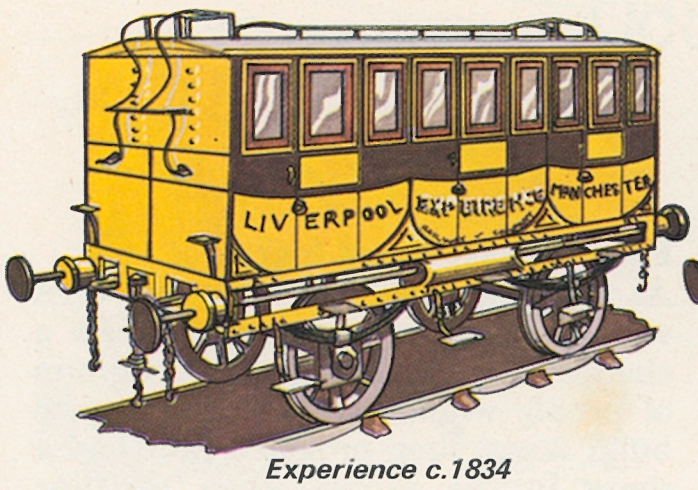


The cut-away drawing (right) shows a typical express engine of 1848.
The flat black rod above the connecting rod is part of the mechanism that opens and closes the steam valves. Note the way in which the exhaust system blows up through the chimney, so increasing the draught.

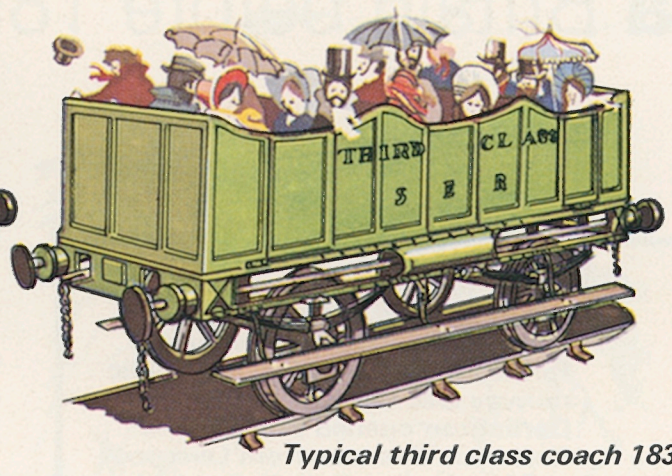
The main parts are the same as in the *Rocket* of 1829, but the detailed design is more advanced.

Typical express engine 1848





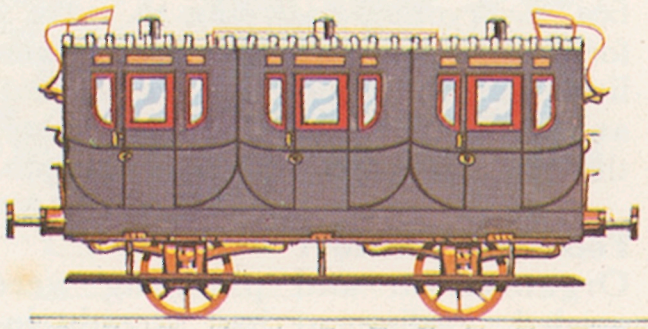
Experience c.1834



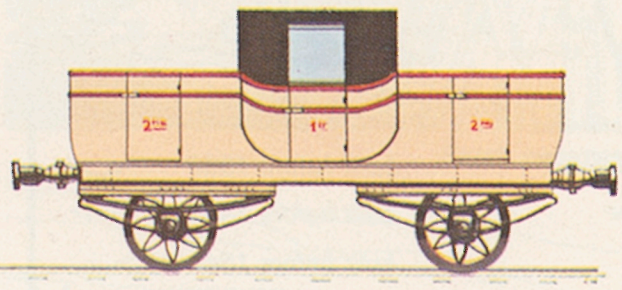
Typical third class coach 1835

The coach *Experience* (far left) was for first class passengers on the Liverpool to Manchester line. Only one compartment had a light in it. The coach had spring buffers and screw couplings.
A typical third class coach of the same railway (left) also had spring buffers. Passengers had to stand in open coaches. When it rained they stood with their umbrellas up. Seats and roofs were only put in third class coaches in 1844.

First class coach 1839



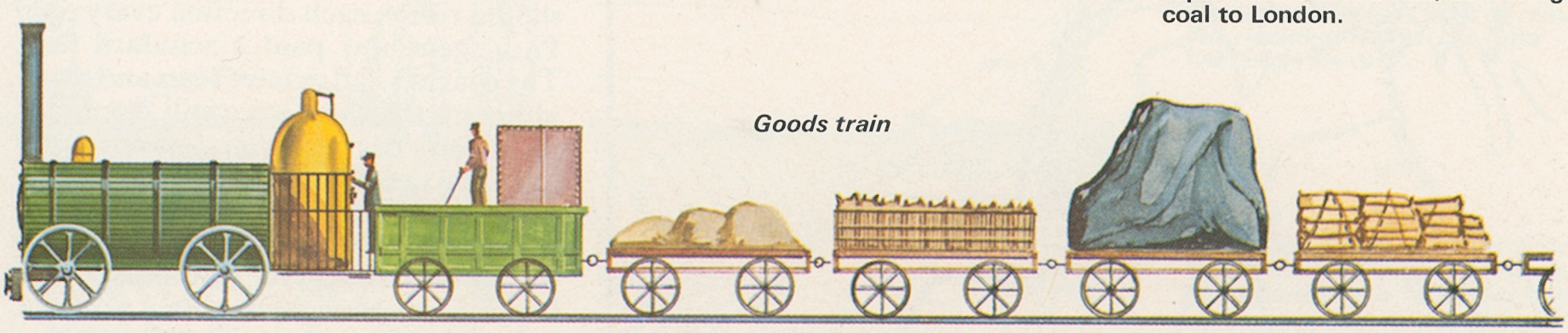
First and second class coach 1841



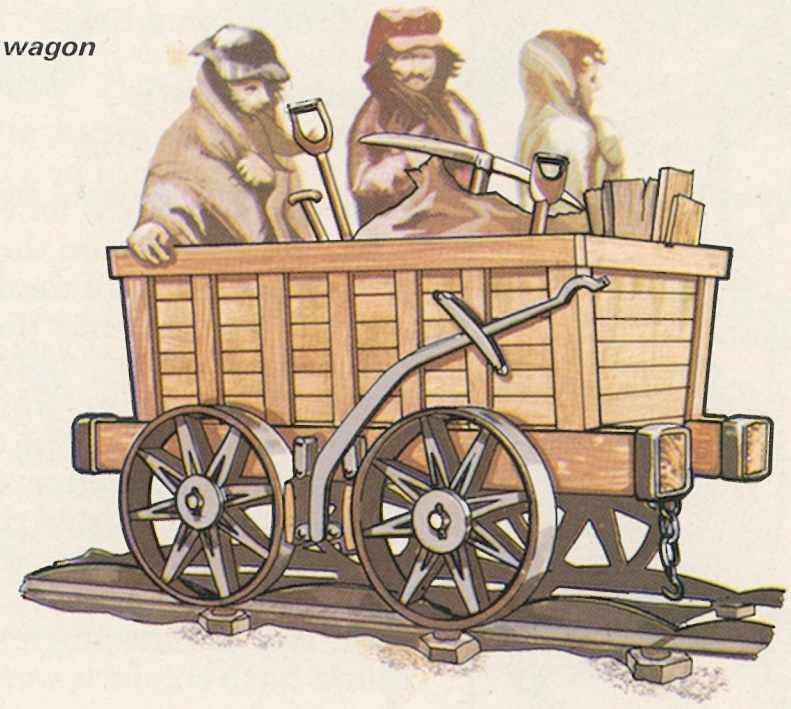
All the compartments of first class coaches (far left) were lit by 1839. By 1841 second class passengers (left) had seats, but no roof. Both coaches ran on the Manchester and Leeds line.

Early goods trains (below) carried anything from cotton and machinery to furniture for house removals. Goods trains now largely replaced the coal boats, delivering coal to London.

Goods train



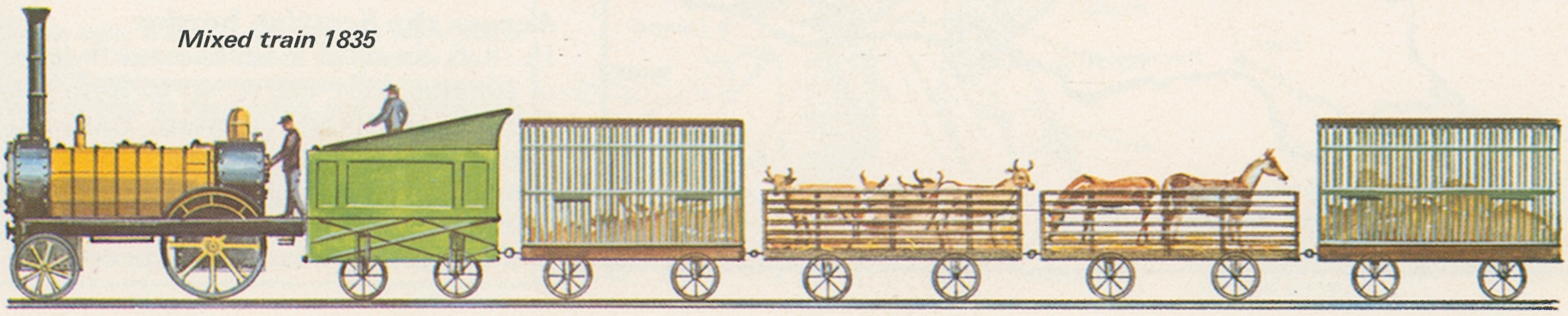
Early goods wagon



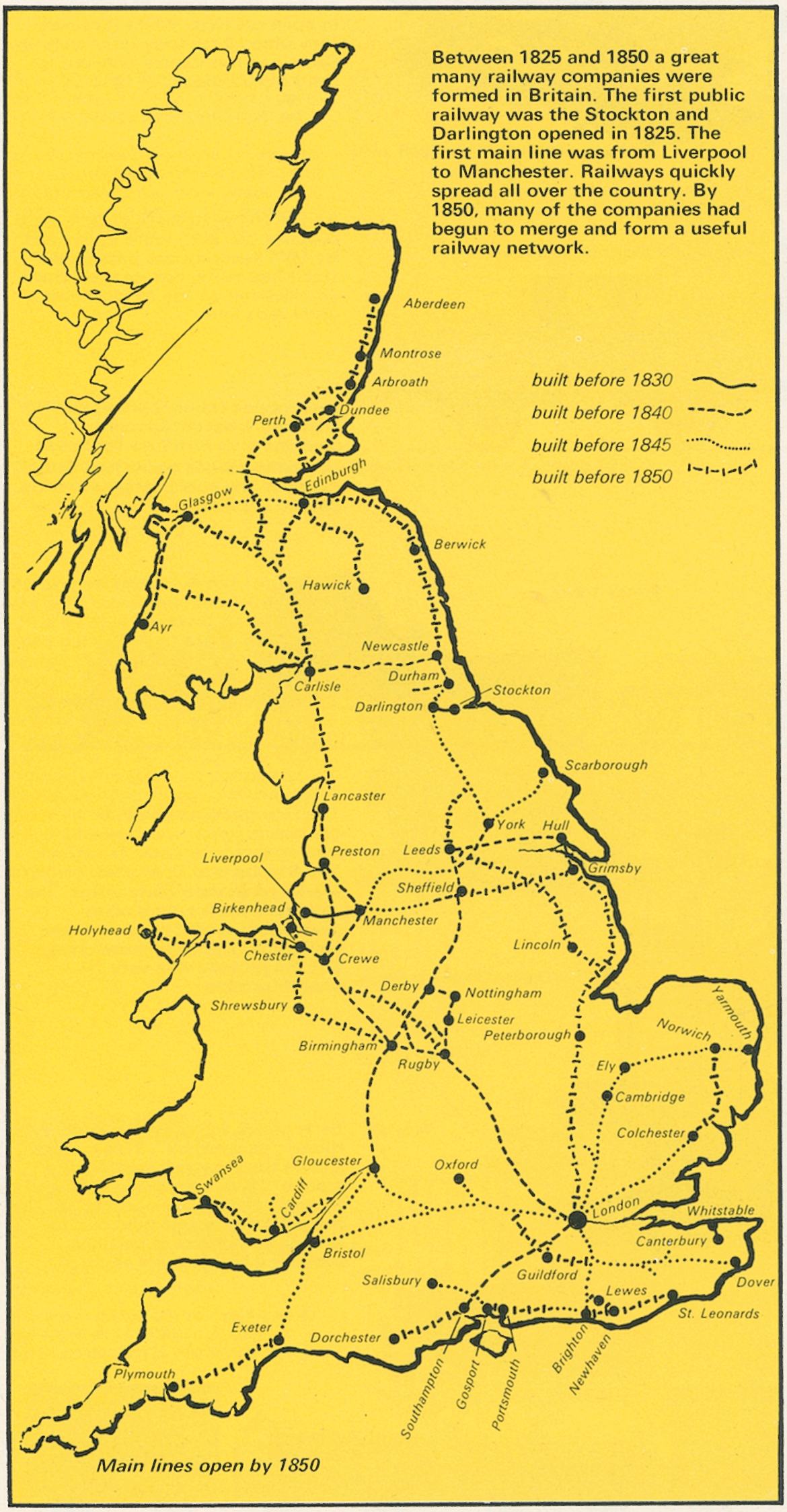
The first goods wagons, or cauldrons (left), were used in mining districts. Later Trevithick and Stephenson used them to carry workmen in their early trains. The first coaches for third class passengers were based on these cauldrons. The fares were cheap, but the journey was very uncomfortable.

Early trains sometimes carried very mixed "passengers". This picture shows the livestock section of a train of 1835, which was followed by some third-class coaches for the mere human beings who had to endure long waits at stations while the beasts were shunted.

Mixed train 1835



Railway mania Britain before 1850



Fortunes won and lost

As soon as the first railway lines were under way, many people saw a chance to make their fortune. A group of people would give some money to build a new line, provided they had a share in the profits when the line opened.

In 1845 the "railway mania" spread fast. Everyone was trying to make a fortune by investing money in new lines. Many proposals were absurd, and Parliament stopped them. Nevertheless a lot of people went bankrupt.

Food and comfort

Organisation and planning were needed. Parliament had already insisted that at least one third-class train should run in each direction every day. Passengers now paid a standard fare. The coaches had to have seats and roofs, although the sides were still open, but for third-class travellers speeds were low. The 143-mile journey from London to Taunton took 16 hours, which must have been very uncomfortable in bad weather. Passengers travelling from London to Manchester or Liverpool had an even worse time. They had to wait for 15 hours when they changed trains at Birmingham.

Improvements

After 1846, a great many improvements were made. The 4 ft. 8½ in. gauge became compulsory, for example. Even refreshment rooms on the stations were introduced. Most of them were run by the railway companies themselves. One refreshment room, however, on the Great Western line from London to Bristol, was run by a firm of contractors. To make sure passengers bought food, the contractors insisted that every train made a ten-minute stop there.

Dining cars on the train did not yet exist. Nor did sleeping cars or corridor trains. Such comforts were still to come.

Across the Scottish border

In 1846, the chief main lines north-west of London were linked up to form the London and North Western Railway, known as the "Premier Line". By 1848 people could travel from London to Carlisle by train. At the same time the first line into Scotland was opened.

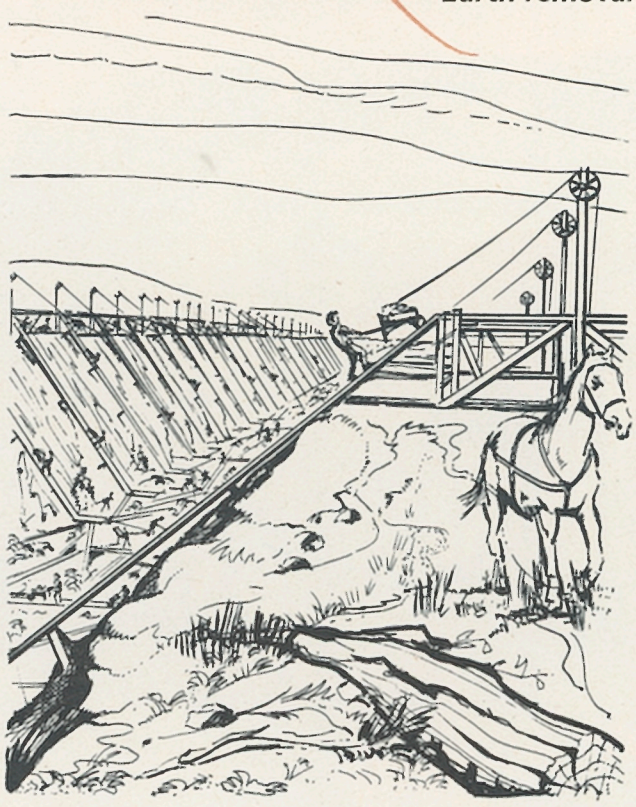
Rock blasting 1835

Earth removal

Hard rocks were blasted with gunpowder (far left). Note that while one line is shown laid on wooden 'sleepers', the other uses the older system of supporting the rails on individual blocks of stone.

In softer soil, earth dug out from cuttings could be moved ahead of the 'permanent way' by contractors' light railways and tipped to form embankments, so forming a level 'roadbed'.

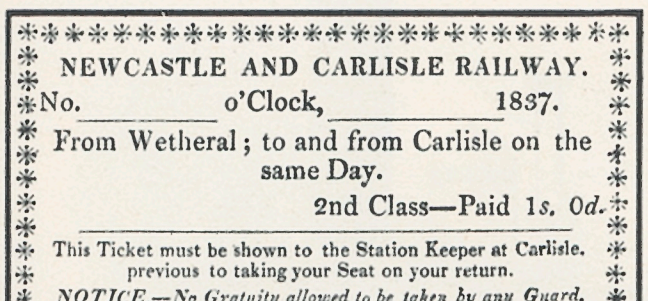
Digging the line into London



Digging in the Chiltern Hills

The early lines were all built by men using hand tools, horses, and gunpowder for blasting. One line into London (far left) was wide enough to take four lines of rails. The retaining wall on the right held back the earth.

Where there were cuttings through chalky country—in the Chilterns, for instance—the 'spoil' was hauled up board-walks. Horses and pulleys provided the power, but men had to do the dangerous work of guiding the wheelbarrows.



NEWCASTLE AND CARLISLE RAILWAY.

No. _____ o'Clock, _____ 1837.

From Wetheral; to and from Carlisle on the same Day.

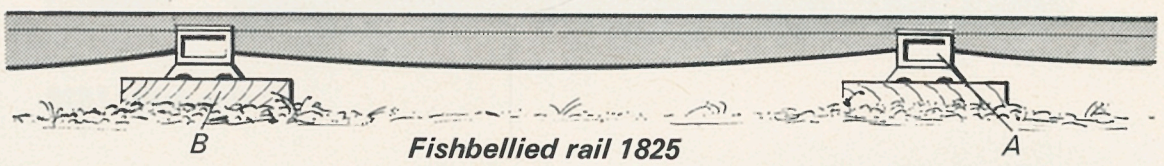
2nd Class—Paid 1*s.* 0*d.*

This Ticket must be shown to the Station Keeper at Carlisle. previous to taking your Seat on your return.

NOTICE.—No Gratuity allowed to be taken by any Guard, Porter, or other Servant of the Company.

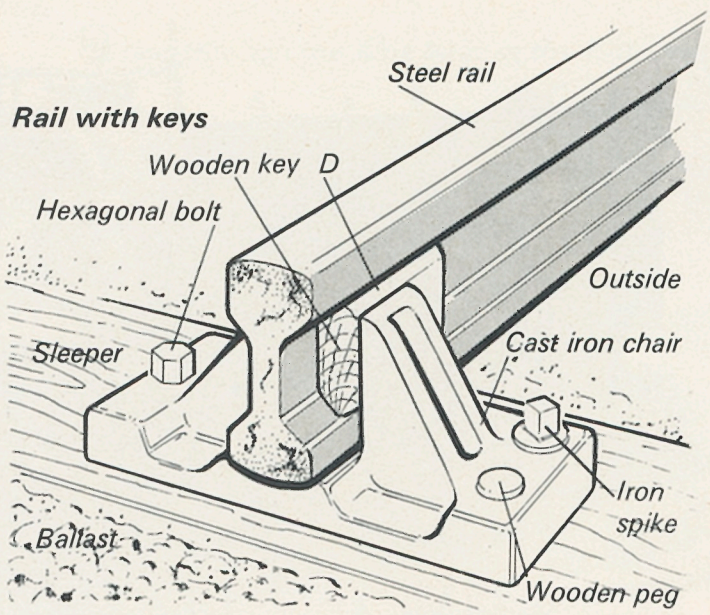
Early ticket

Some early train tickets (above) were made of paper. Each one had to be filled in by hand. Passengers sometimes had to supply such details as their name, age, address, job, where they were going and why.
Cardboard tickets came into use in 1841. They made things much easier. They were simply date-stamped as they were sold.



Fishbellied rail 1825

The early rail shown (above), though so weak that it had to be 'fish-bellied' between its supports, already showed the idea of mounting the rail in a 'chair' (A). This was itself fixed to a support (B) which might be surrounded by gravel ballast.



Rail with keys

Later rails (bottom left) had wooden wedges, or keys, to hold the rails in the chairs. From about 1860, iron rails began to be replaced by steel.

Railways spread through Europe

Every country in Europe began to build a system of railways. By 1860 France had a very useful network. Prussia, a German state and a great military power, had an even better system.

International expresses were soon running between different capital cities. At one time, only rich people could afford to travel. The railway soon proved to be much cheaper than travelling by coach, largely because it was so much quicker. It had taken Napoleon two weeks from Paris to Vienna by coach. The same journey by train now took only two days.

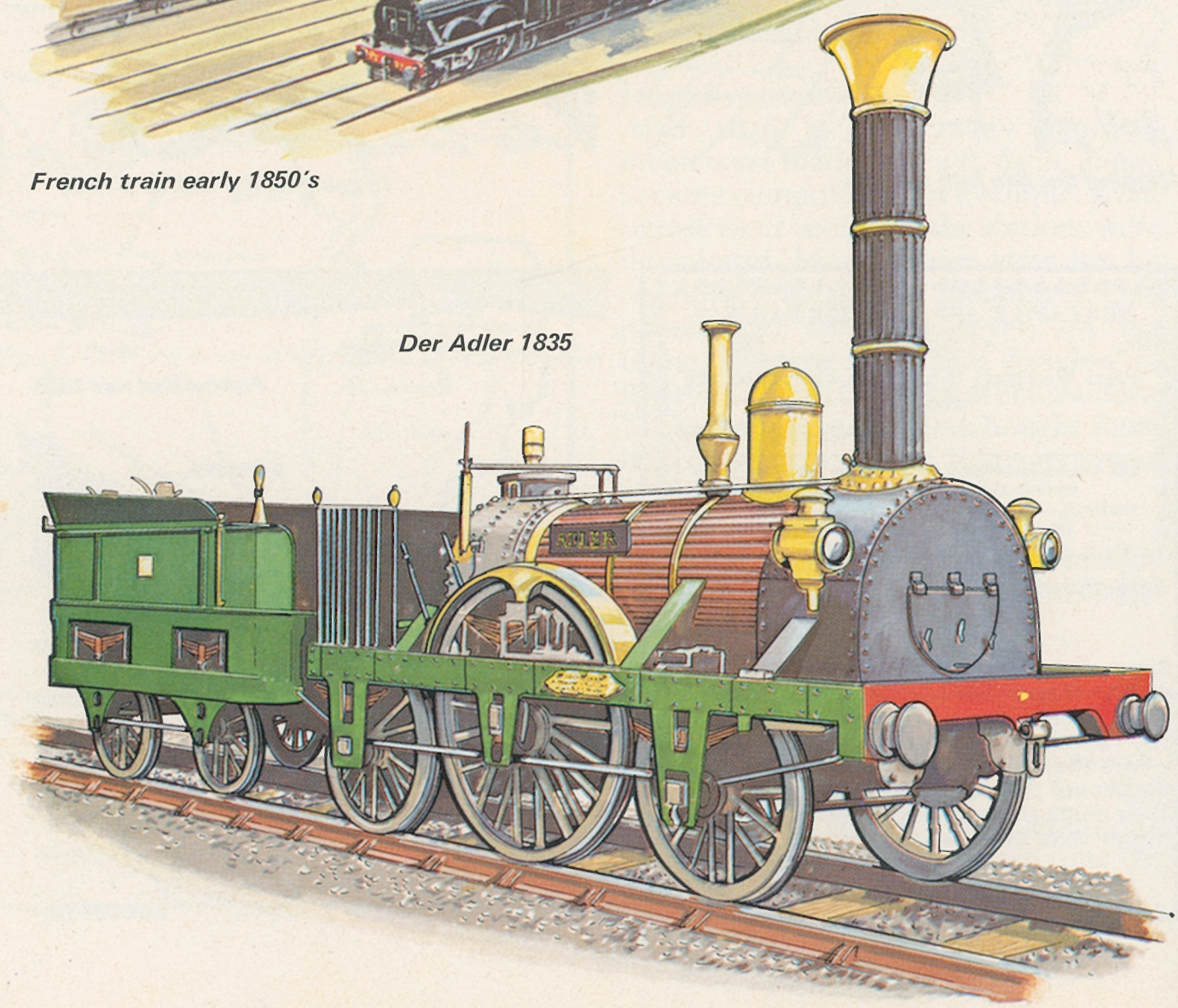
Partly through the influence of British engineers, most Continental countries adopted the 4 ft. 8½ in. gauge. This meant that through running was possible everywhere except in Russia, Spain, Portugal and Ireland, where the gauge was 5 ft. or more.

But "gauge" in the sense of the distance between rails is not the only limit to a railway. There is also "loading gauge"—the maximum height and width imposed on trains by such matters as clearance under bridges. Here there is less standardisation, unfortunately, even today.

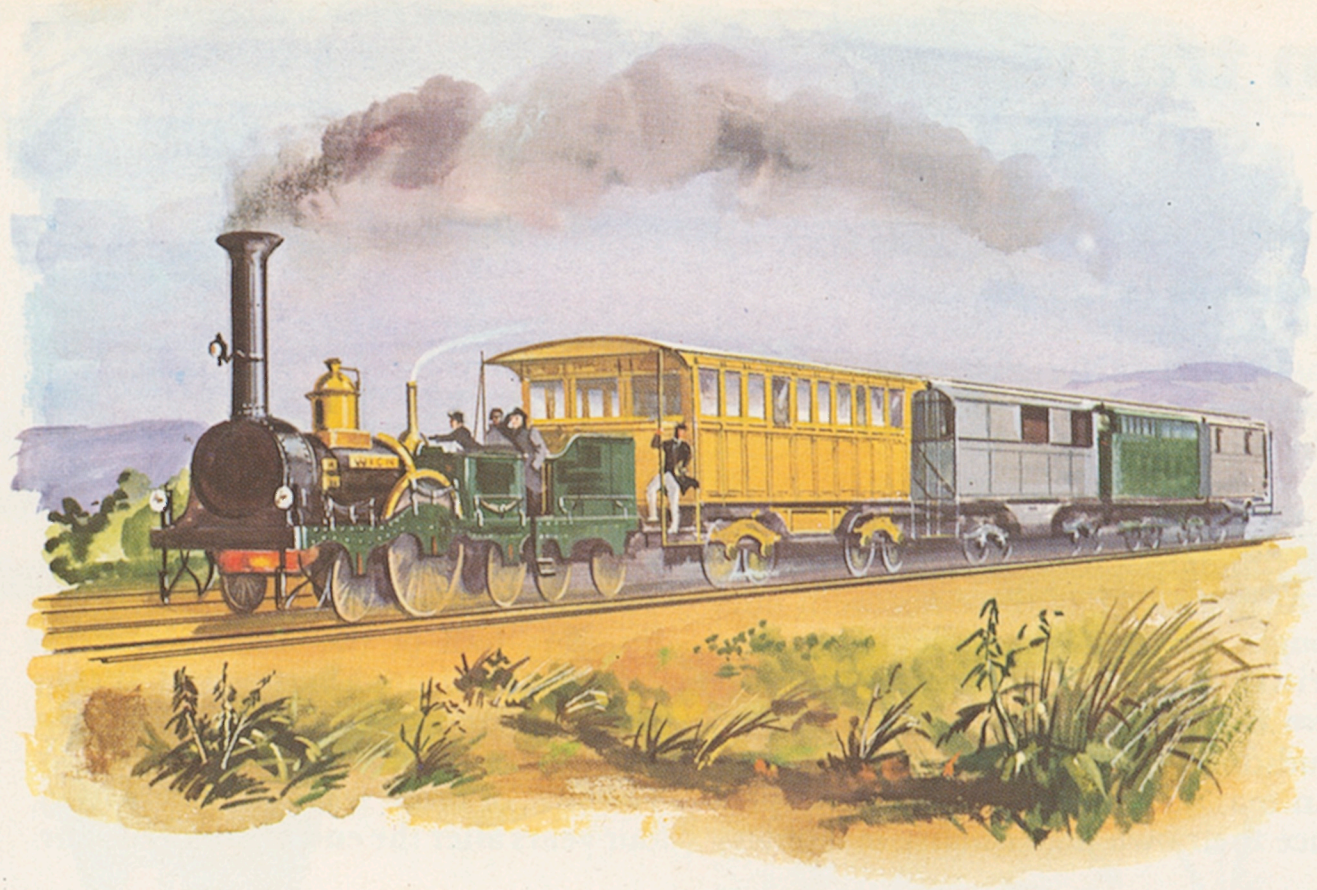
French railways were strongly influenced by Britain. The train (right) is from Strasbourg to Paris, and ran in the early 1850's. The engine looks very like those built for the Grand Junction railway in England, but it was probably built in France. The trains also ran on the left hand track, as they did in England.

French train early 1850's

Der Adler 1835



The engine for the first German train (right) was built by Robert Stephenson, George Stephenson's son, in 1835. It was called *Der Adler* (the eagle). The train had one open-sided coach and one with closed-in compartments.



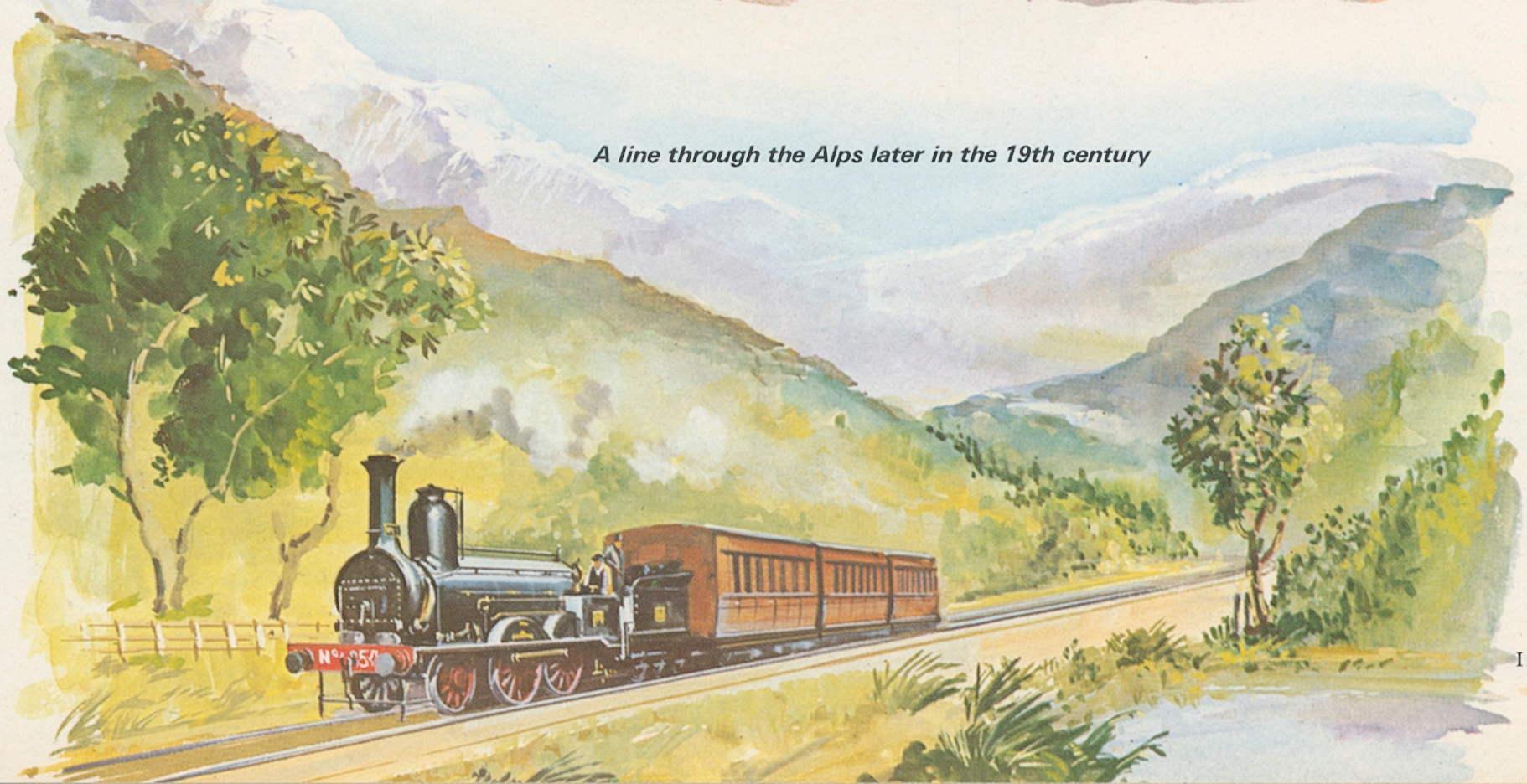
Austrian express 1847

Austria took the lead in taking a railway over and through really tough mountain ranges.
The engine of the Austrian express (left) has many British features. The coaches are American in style, especially the wheels and the end platforms.

Over the years Spain (below) had been often invaded by its neighbour, France. When the railway age began, Spain decided to protect itself by choosing a different rail gauge from the standard 4 ft. $8\frac{1}{2}$ in. gauge used in France. Spain therefore chose a wide gauge of 5 ft. 6 in. which meant that no French trains, troop or otherwise, could cross the border. Portugal adopted the same gauge as its neighbour Spain.

Spanish scene mid-1800's

For many years, Italy was cut off from the rest of Europe by the tremendous natural barrier of the Alps (below). The first line to defeat this problem used the historic Brenner pass out of Austria. Then a much more ambitious route was built to link Paris and Rome by way of the eight mile Mont Cenis tunnel. This was completed by 1871. Until the middle of the 19th century, Italy consisted of many independent states, but they all adopted the standard gauge. When the states united to become a nation, the new country already had an efficient railway system that could take through traffic from other European countries.



A line through the Alps later in the 19th century

Early American trains

Railroads open up the West

19th century England was already developed and built up. Railways were built to make trade and travel much easier than before.
In North America, however, there was very little development of the inland country. Railways were pushed into the interior to open up this vast continent. In other words, the railways arrived first and civilisation followed them. Building was difficult. All materials had to be carried to the site, and the land had to be cleared.

Railroads in Carolina

An entirely steam-operated railroad was opened in North America in South Carolina in 1830. It had a 5 ft. gauge, which became usual in the South until after the Civil War of 1861–65. The railroads in the North largely adopted the standard 4 ft. 8½ in. gauge, though.

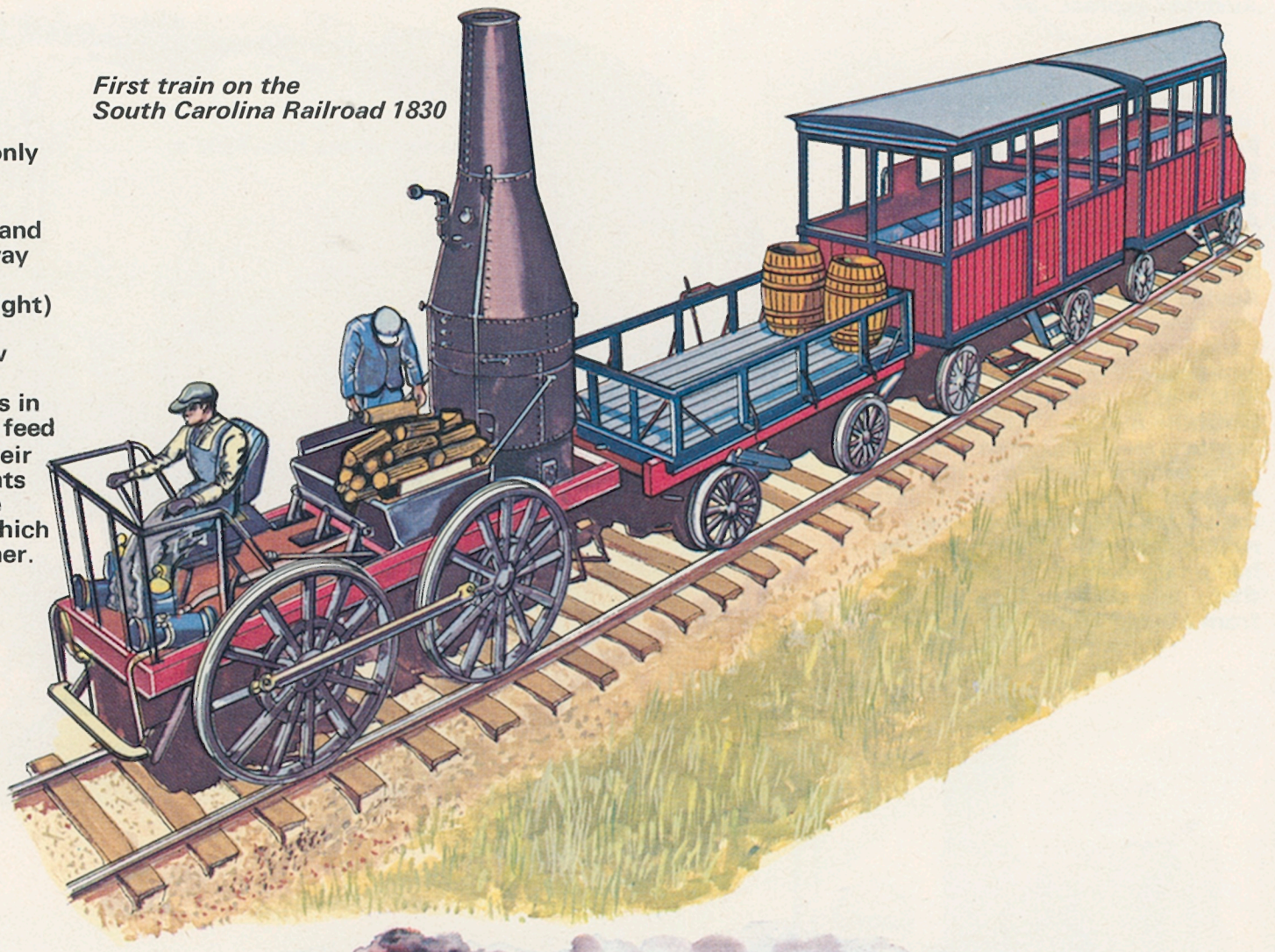
At first, some of these northern lines bought engines from England. The British-built locomotive *Stourbridge Lion* ran on test on the Delaware and Hudson line in 1829. However, American manufacturers soon began to produce their own high quality machinery and passenger and freight vehicles.

In America, iron was difficult to obtain and the rails were not very strong. To give more support, the cheap wooden sleepers, called ties in America, were laid very close together.

Transcontinental line

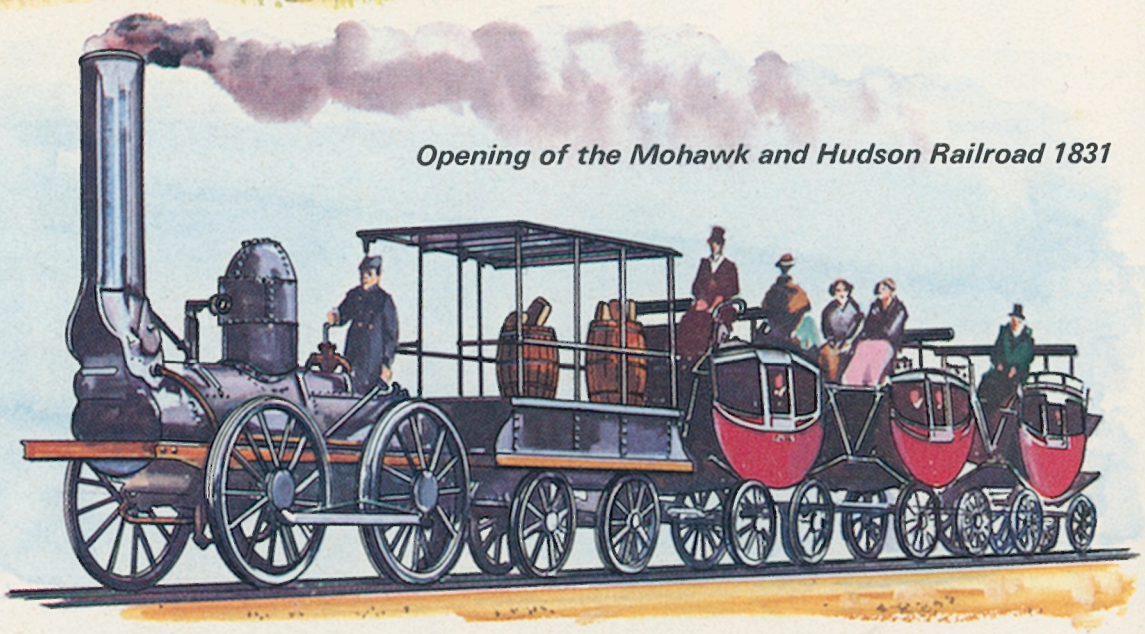
By 1835 half of the world's railways were in the United States, and as they pushed inland from the East Coast the idea of a transcontinental line was born. The first of these was opened in 1869, four years after the end of the Civil War.

First train on the South Carolina Railroad 1830



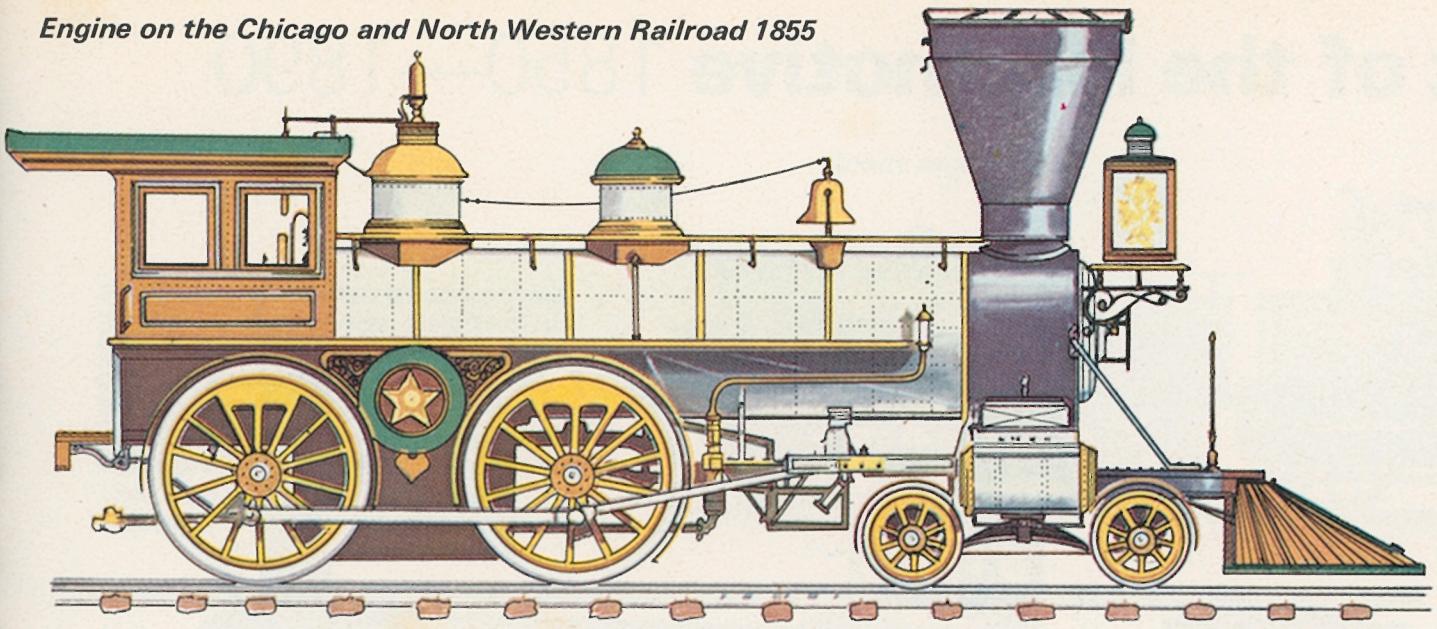
A short section of the South Carolina railroad was opened only three months after the English Liverpool and Manchester line. By 1833 it was 136 miles long, and far longer than any other railway yet built.
The engine of the first train (right) was called *The Best Friend of Charleston.* It was built in New York. The vertical boiler was wood-fired and the two barrels in the tender probably contained feed water. In the carriages with their wagonette-type bodies the seats were back to back. There were canvas side and end screens which could be lowered in bad weather.

Opening of the Mohawk and Hudson Railroad 1831

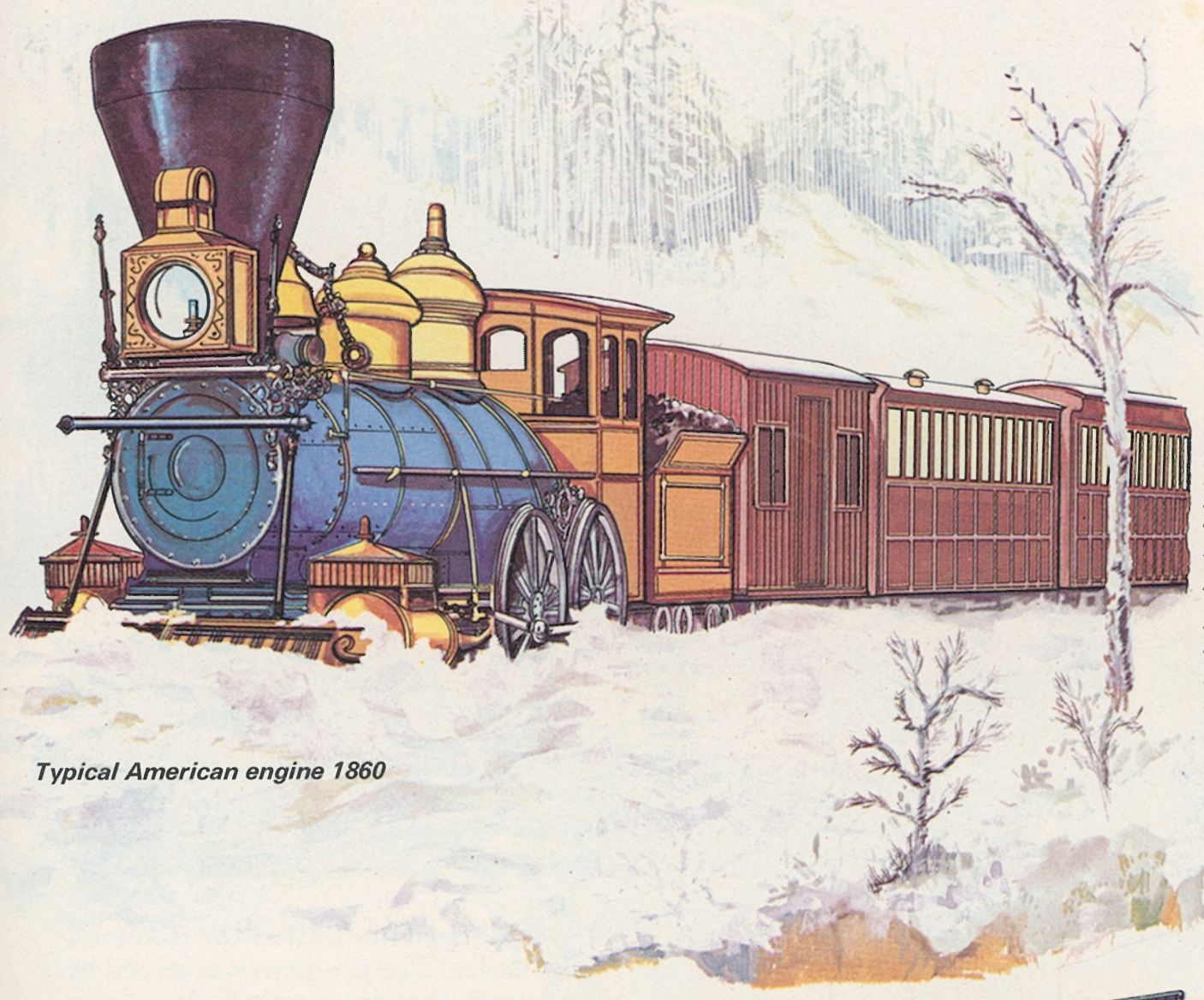


The Mohawk and Hudson Railroad was opened in 1831 (right). Unlike *The Best Friend of Charleston,* the engine had a horizontal boiler. It was called *De Witt Clinton.* But it broke down, and the second train had to be drawn by horses.
The carriages look like ordinary road coaches mounted on railway wheels. This type of vehicle did not last long in the United States.

Engine on the Chicago and North Western Railroad 1855



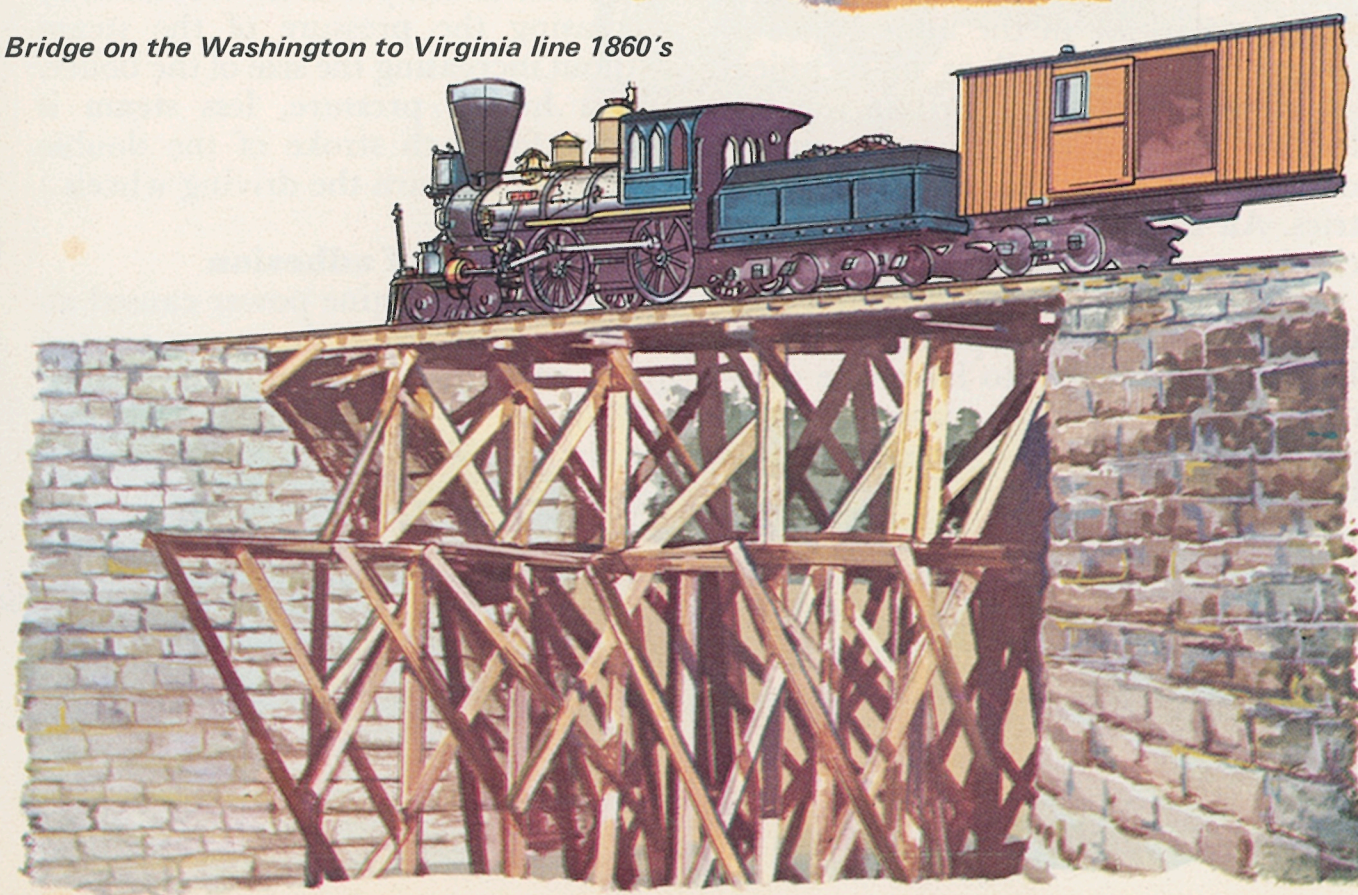
By the 1850's American engines had developed their own style. The first tracks were often laid quickly and roughly. To make the ride smoother, a small, four-wheeled, pivoted front unit was added to the engine. It was called a bogie, and it guided the front of the engine very well. Because of its good riding it was also used for tenders and passenger and freight cars. Longer and better passenger vehicles could be carried on two bogies. The engine (left), which belonged to the Chicago and North Western Railroad is a well-finished American engine. The cowcatcher, headlamp and large cab for the crew were a few of the improvements.



In winter a huge headlamp was necessary to light up large obstacles like snow-laden trees, which often fell across the line. Sometimes the light track broke up, either from severe frost or floods or from the weight of an earlier train. Forest fires were another hazard. The cowcatcher swept away smaller obstacles, such as animals that strayed on to the line.
There is much decorative work on the engine (left), but, as on most American engines, there are no splashers—or mudguards—over the coupled wheels. In bad weather the wheels would get wet and spin on steep or poor rails, so the rails had to be sanded to give the wheels a better grip.

Typical American engine 1860

Bridge on the Washington to Virginia line 1860's

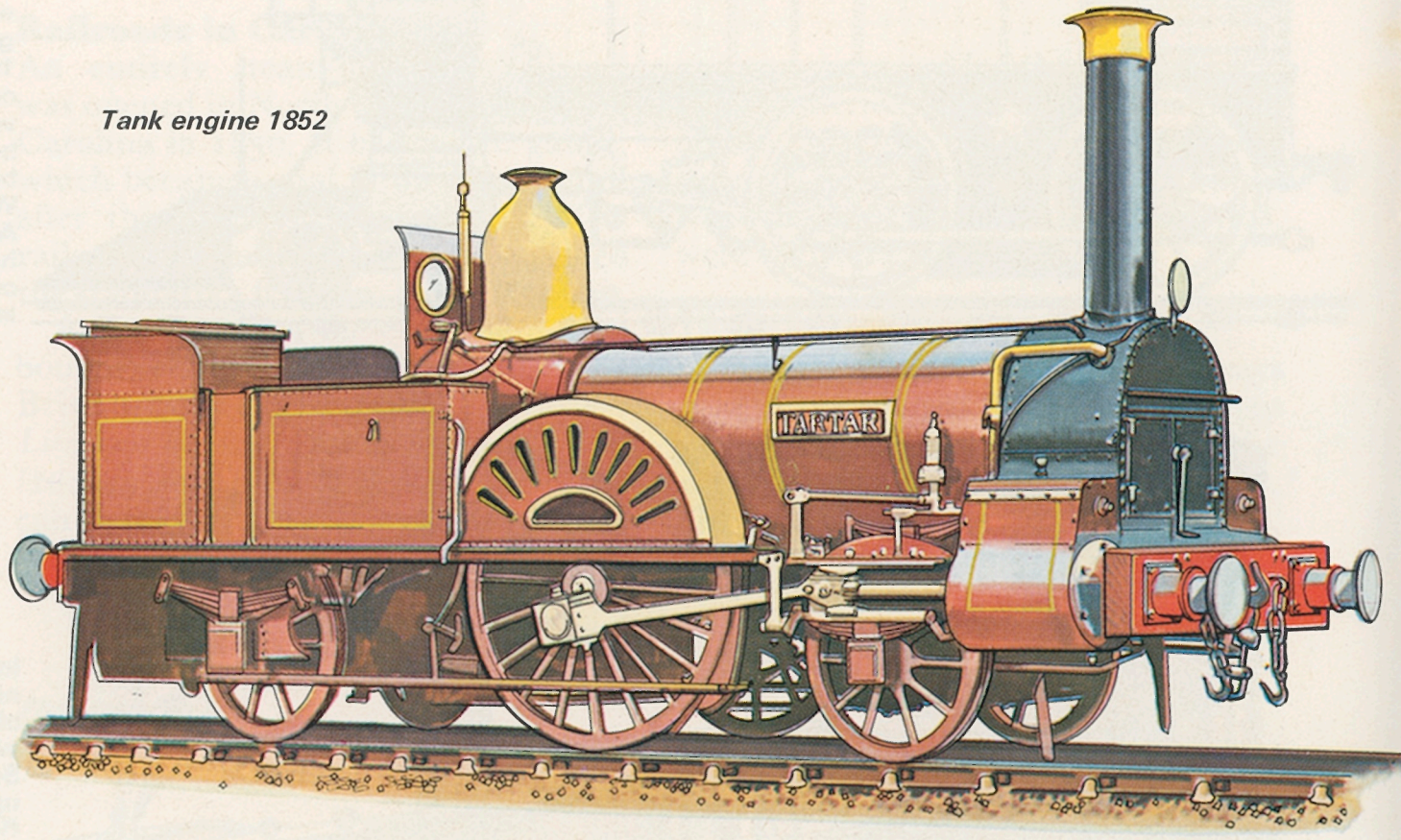


The American Civil War, from 1861 to 1865, affected American railways. Vast armies were employed and for the first time troops could be assembled quickly by rail. Supplies of all kinds were conveyed to appropriate railheads, and in places there was much raiding and fighting to destroy the railroads and their depots.
One bridge (left) which was raided and wrecked was on the line from Washington into Virginia. Military engineers repaired it temporarily, as shown.

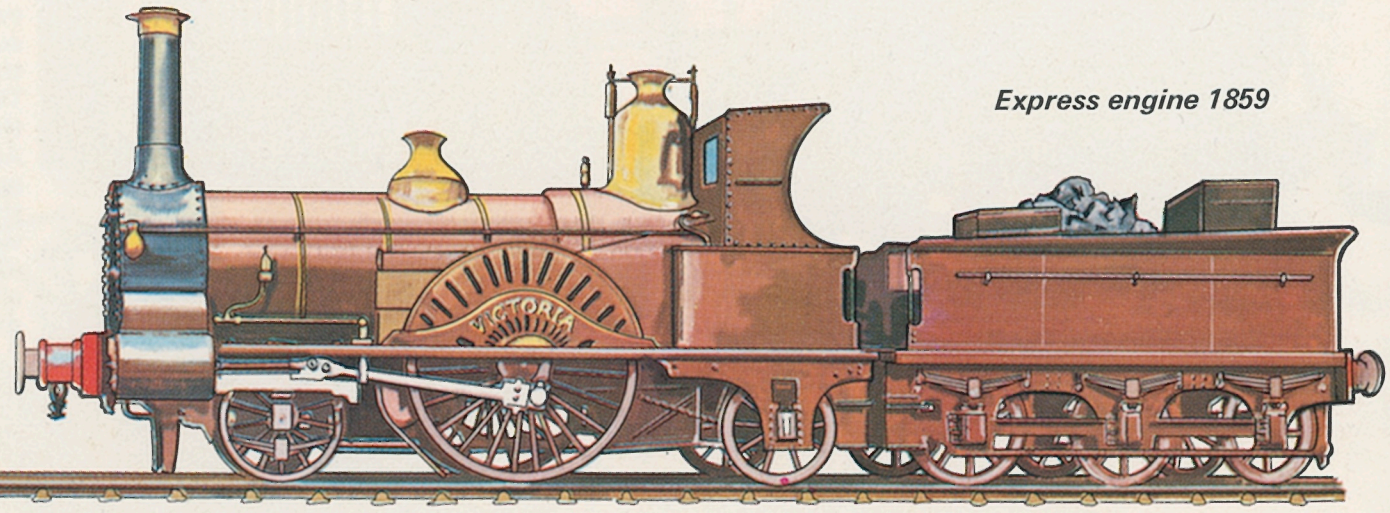
Development of the locomotive 1850—1890

Steam locomotives are classed by a code of three numbers showing the number of wheels on the leading bogie, the driving wheels and the trailing wheels.
The *Tartar* tank engine (right) is a 2-2-2 WT (well tank) engine from the London and South Western Railway. Instead of carrying the water tanks along either side of the boiler, the WT type of tank engine has a single tank beneath the footplate and coal bunker.

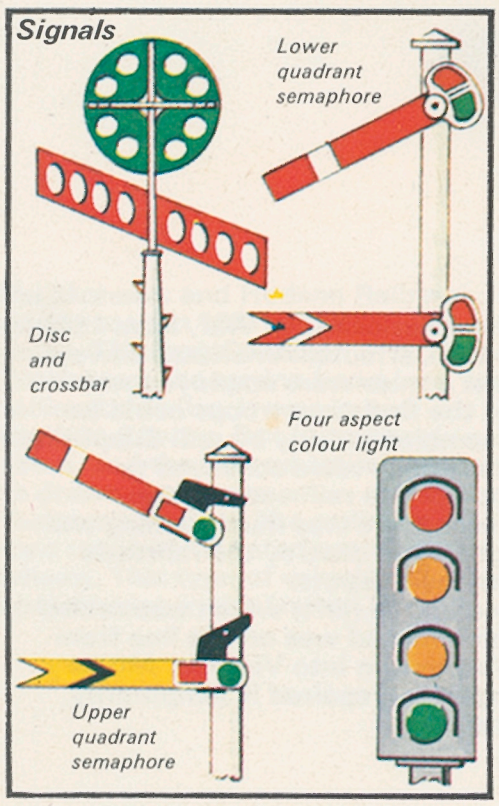
Tank engine 1852



The London and South Western Railway 2-2-2 *Victoria* (right) was built in 1859, but the cab was added later. The driving wheel is 6 ft. 6 in. in diameter.
The *Victoria* was the last "single" to be built for this railway. A "single" is a locomotive with just one pair of driving wheels.



Express engine 1859



Changes in design

By 1850, designers were beginning to take great pride in the appearance of their engines, as well as in technical progress. At this stage, Britain was still leading the rest of Europe in engine design, and exporting to many countries. All the major advances in design can be seen in British-built models.

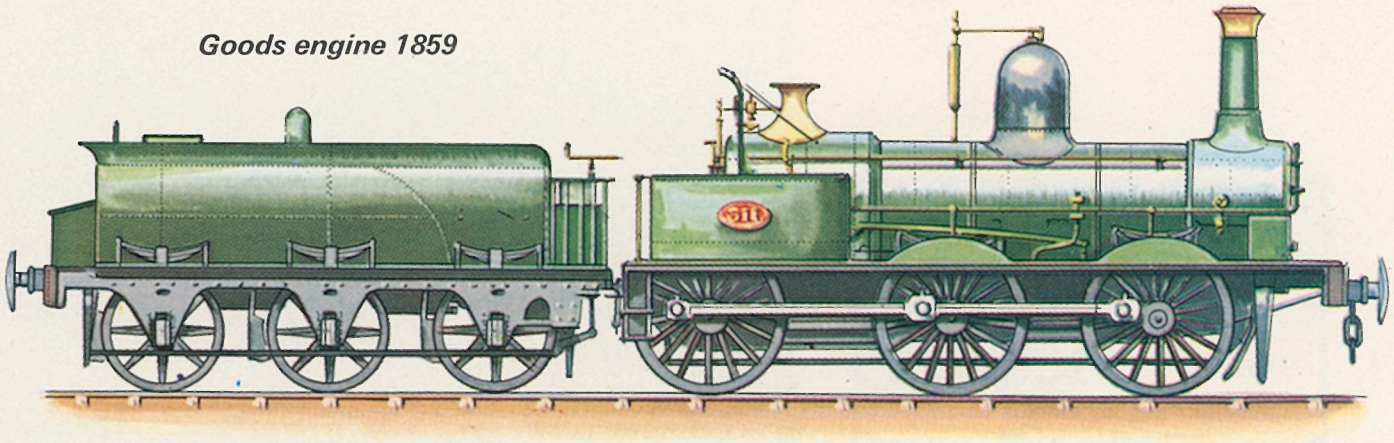
Technical advances were largely concerned with speed and power. It would have been practical to have one standard design for both passenger and goods. But the "single" engine seemed best for passenger trains, and engines with several coupled wheels best for hauling goods. Speed depends largely on the diameter of the driving wheels. The "single" engine type had a single large driving wheel rising on each side of the boiler. This limited the diameter of the boiler. The problem was solved by increasing the pressure of the steam without increasing the size of the boiler. (At a higher pressure, less steam is needed for each stroke of the double pistons which turn the driving wheels.)

The problem of adhesion

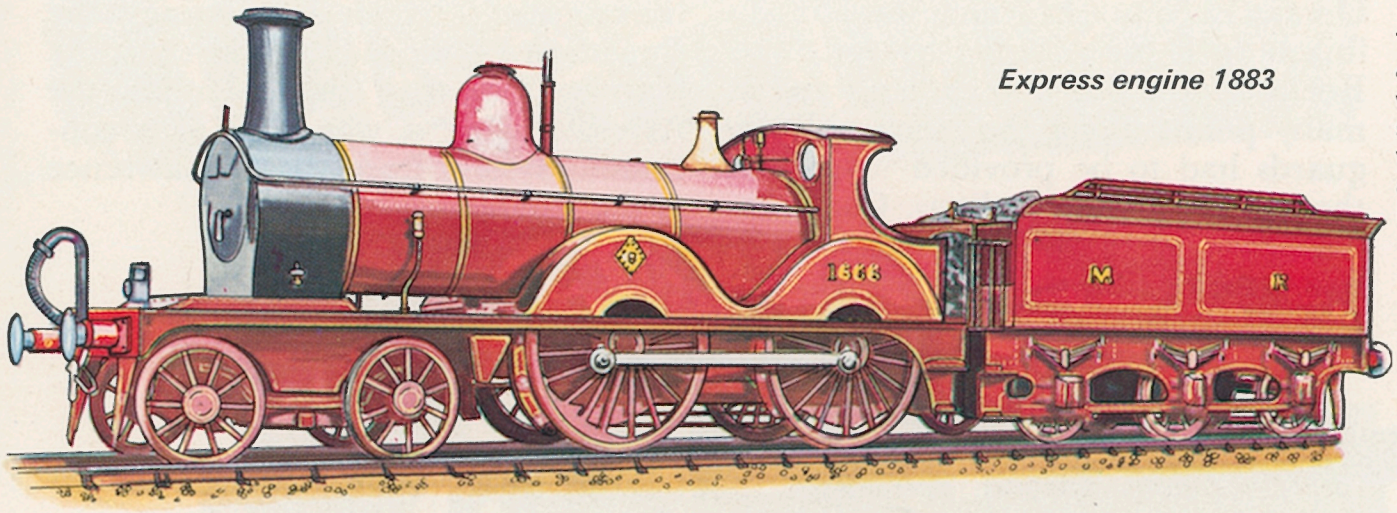
An increase in engine power caused an adhesion problem. If the power was too great, the driving or coupled wheels would lose their grip on the rails and simply spin round freely. If, however, the weight on the axles was increased to prevent this spinning, the rails might not be strong enough to take the extra weight. In the latter half of the century strong steel rails replaced the existing iron ones, which solved this problem.

Goods engine 1859

The dark olive-green goods engine (right) on the London, Brighton and South Coast Railway has a neat but stark design. It is remarkable because of the height of its dome. The 4 ft. 9 in. diameter coupled wheels were originally secondhand cast iron ones, but these were replaced with the standard pattern.



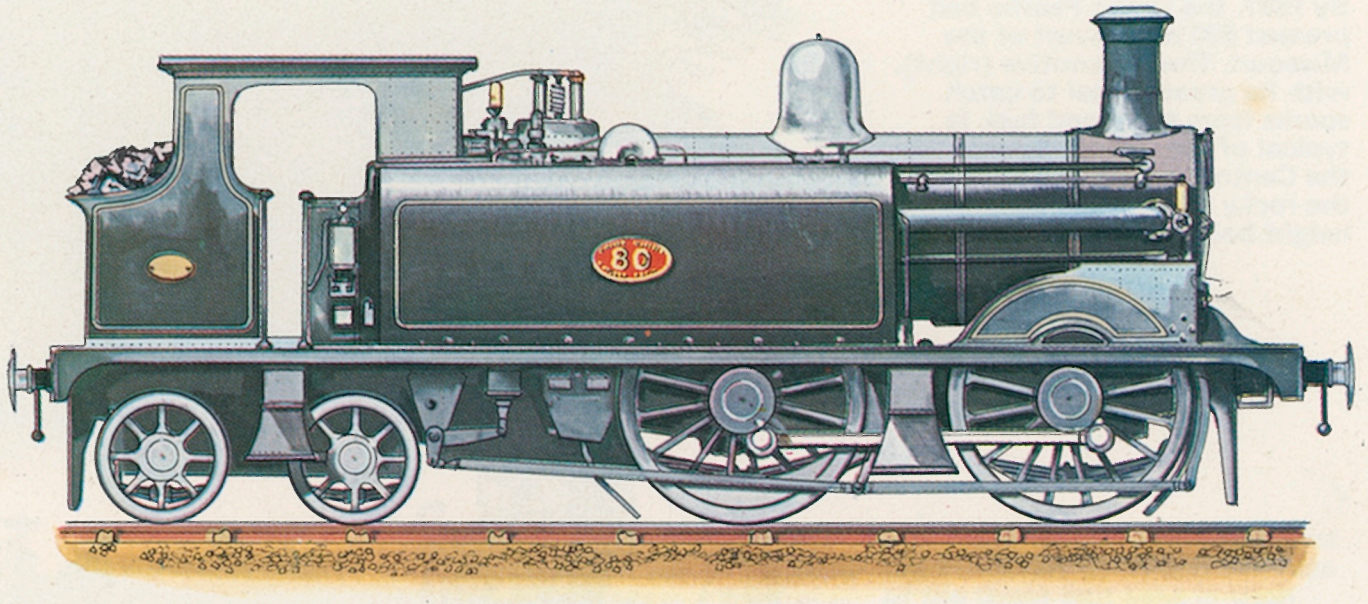
Express engine 1883



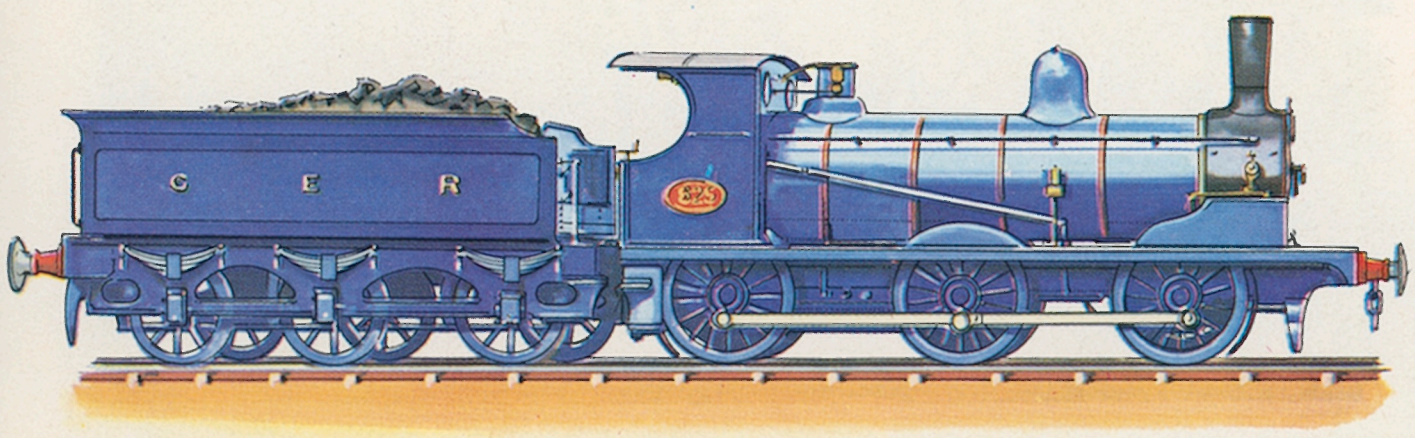
The design of the Midland Railway 4-4-0 No. 1666 express (left), is well-proportioned, neat and symmetrical. This class of engine was fast and ran very smoothly although the boiler was not large. It was built at Derby in 1883.

Tank engine 1883

Robert Stephenson built the London, Chatham and Dover Railway tank engine 0-4-4 No. 80 (right) in 1883. The engine was fitted with condensors for turning the exhaust steam back into water: note the pipe in front of the tank. This was to prevent the tunnels filling with steam on London's underground lines.



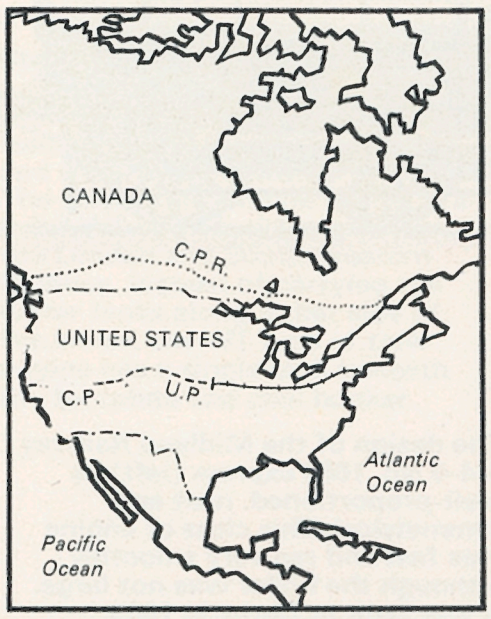
Goods engine 1887



This goods engine of 1887 (left) was built at Stratford in East London.

This was an extremely successful design. It remained the standard Great Eastern Railway goods engine class from 1883 until the end of the century and 289 engines were built to this pattern. They could go almost anywhere and provide a good example of successful standardization.

First transcontinental railways in America



Map of North America showing two transcontinental railroads; the Canadian Pacific (C.P.R.) in Canada and the Union Pacific (U.P.) linked to the Central Pacific (C.P.) near the Great Salt Lake.

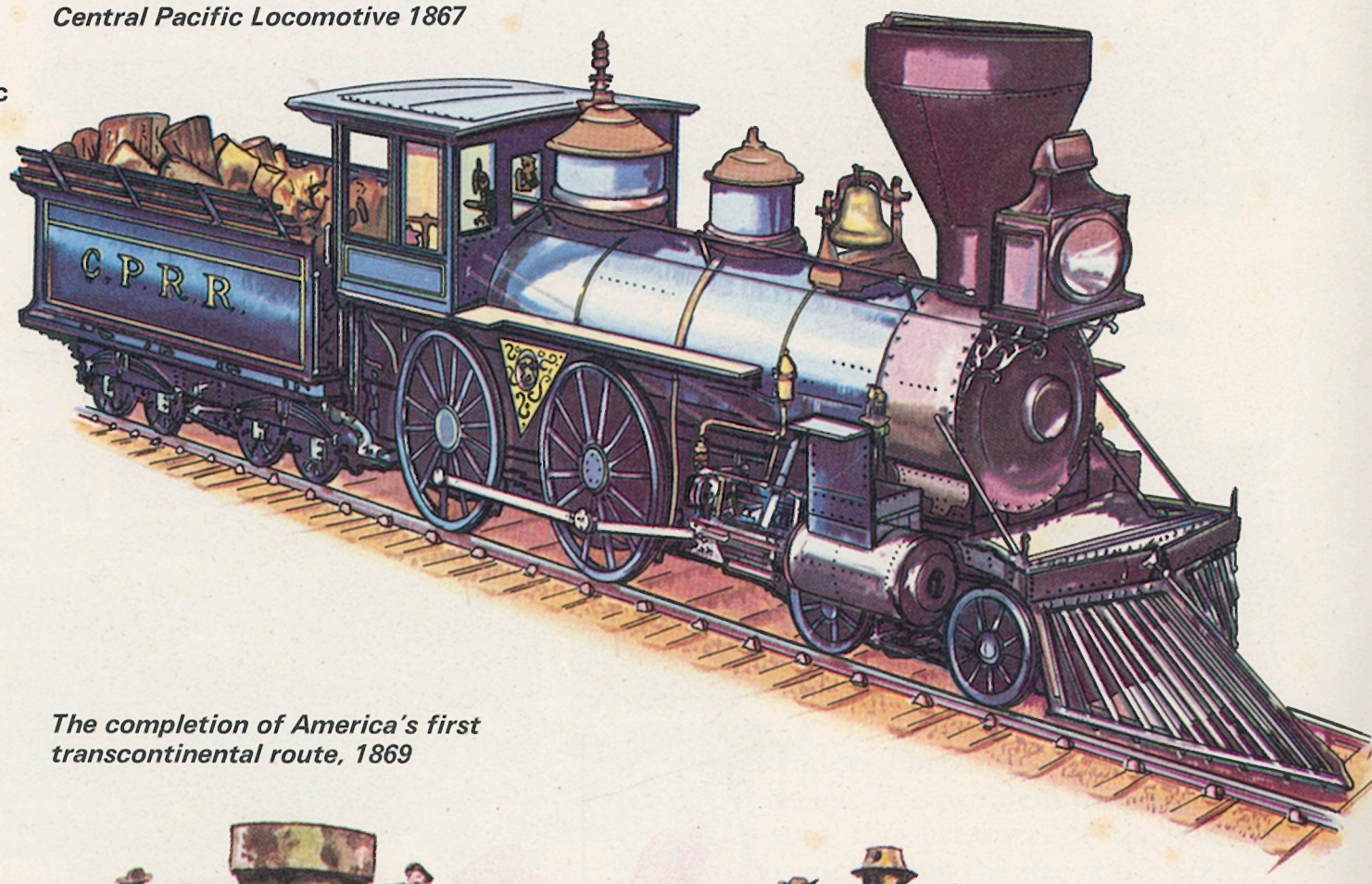
When the United States took California from Mexico in 1846, travel overland was very difficult. The practical solution was to build a railway and the projected line was started westwards from St Louis in 1851 but it did not get beyond Kansas City.

Then in 1862–3 two lines were begun, the Central Pacific from San Francisco in the west, and the Union Pacific from Omaha in Nebraska which was already linked with the Atlantic by rail. The Rocky Mountains were difficult and in many points along the route military guards had to be provided to protect the workmen from Indians. Construction was also delayed by the Civil War. The two approaching lines were eventually joined in 1869. The first transcontinental rail road was completed: more were to follow very soon.

Canadian Pacific

Meanwhile, Canada had decided to follow suit. It then took five months to cross from Montreal to Vancouver in the summer, but after the opening of the Canadian Pacific Railway in 1885, the journey took five days. Unlike the American line it was built as a continuous system from the St Lawrence to the Pacific.

Central Pacific Locomotive 1867



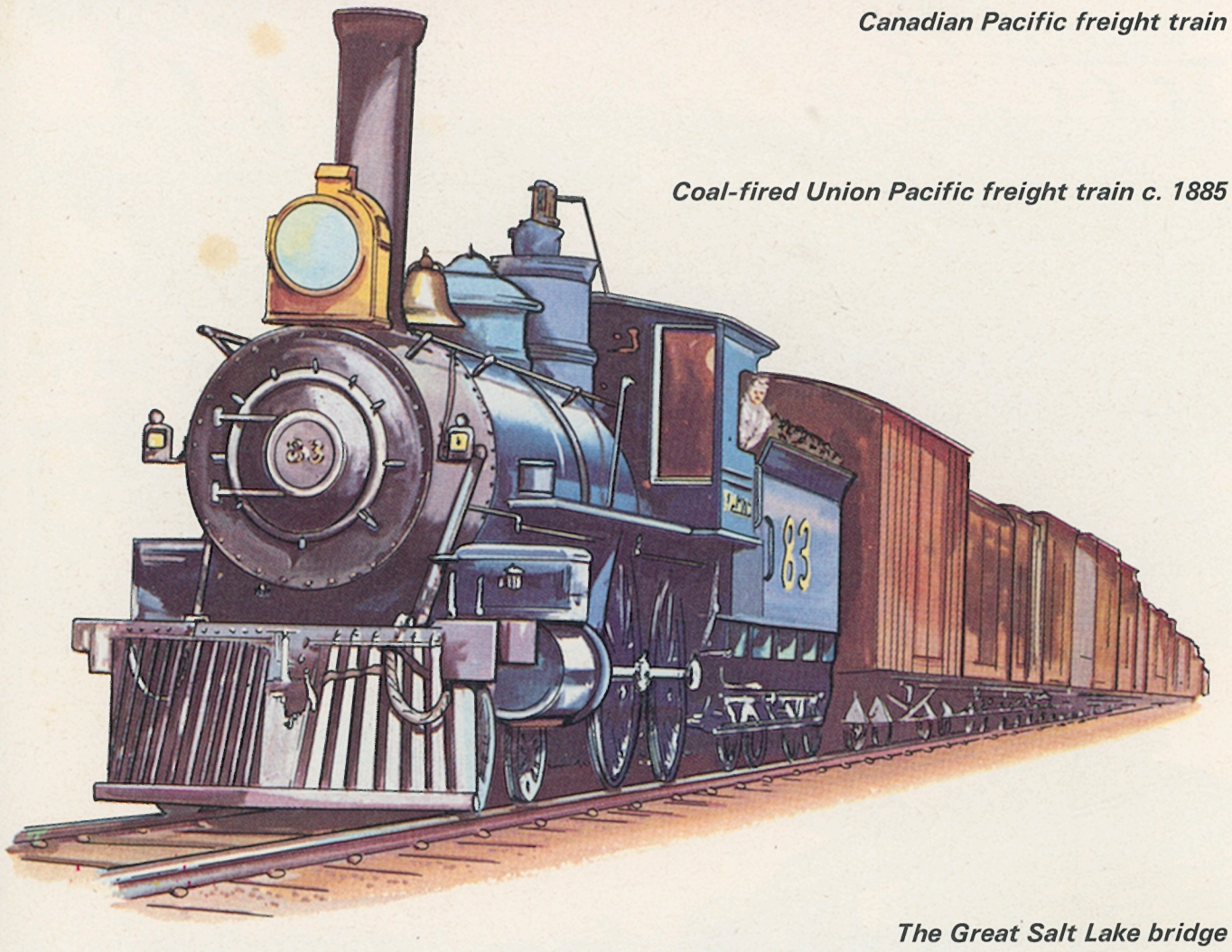
By 1867, the Union Pacific had pressed 500 miles west of the Missouri. The locomotive (right), with its great funnel to catch sparks from the wood fuel, is typical of the period. By this time the Central Pacific had got over the rocky Sierras, the summit height being over 8,000 ft.

The completion of America's first transcontinental route, 1869

The meeting-up of the two sections of America's first true transcontinental line was a great occasion, marked by the driving of a golden spike, the flashing of telegraph messages, and the ringing of church bells throughout the newly-united States. The picture (right) shows the scene on the spot as the two crews meet.

Since building stone was hard to come by and expensive in much of America, wood was used for the construction of bridges as well as fuel. A freight train (left) is crossing a very high wooden trestle bridge.

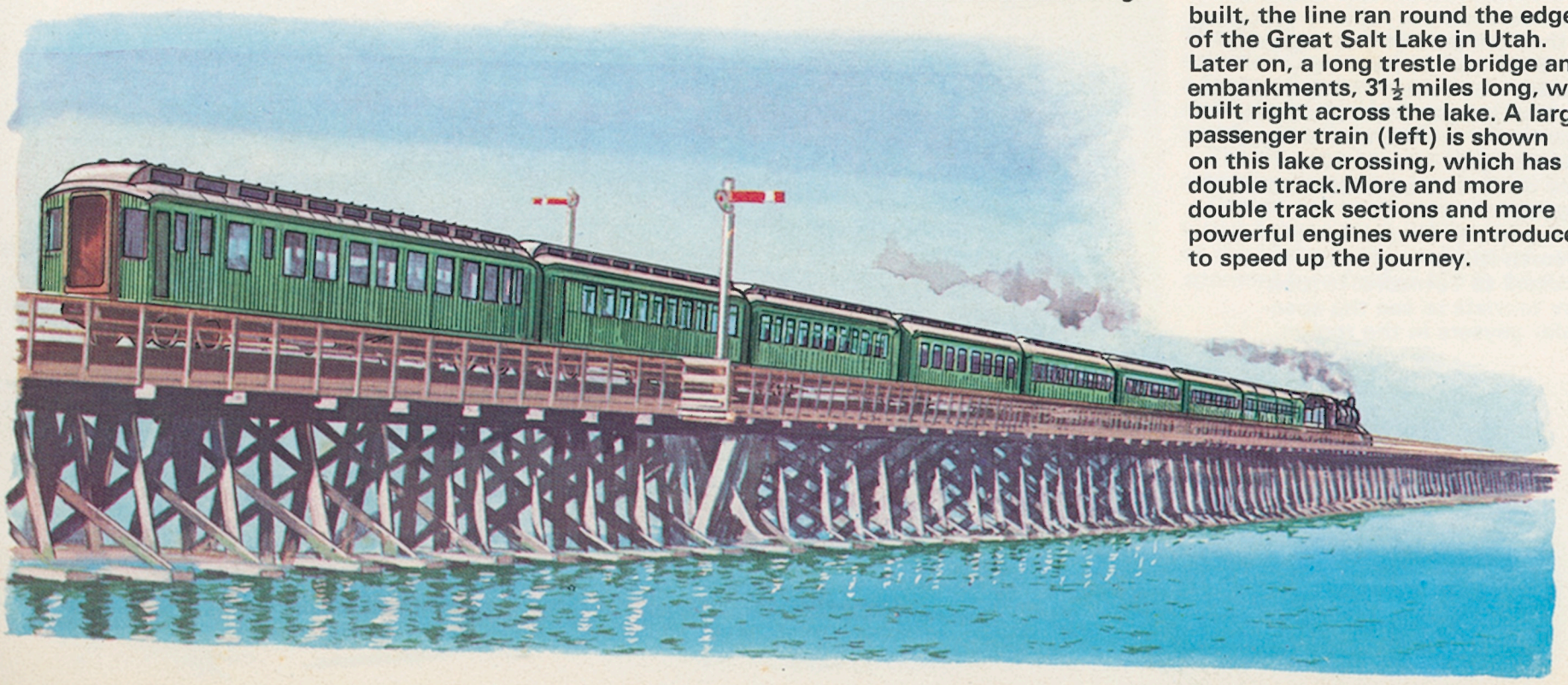
Canadian Pacific freight train



Coal-fired Union Pacific freight train c. 1885

This Union Pacific freight train (left) of about 1885 had a 4-4-0 engine, a small boiler, but big cylinders. The engine was coal-fired, and therefore had no spark-arresting chimney.

The Great Salt Lake bridge

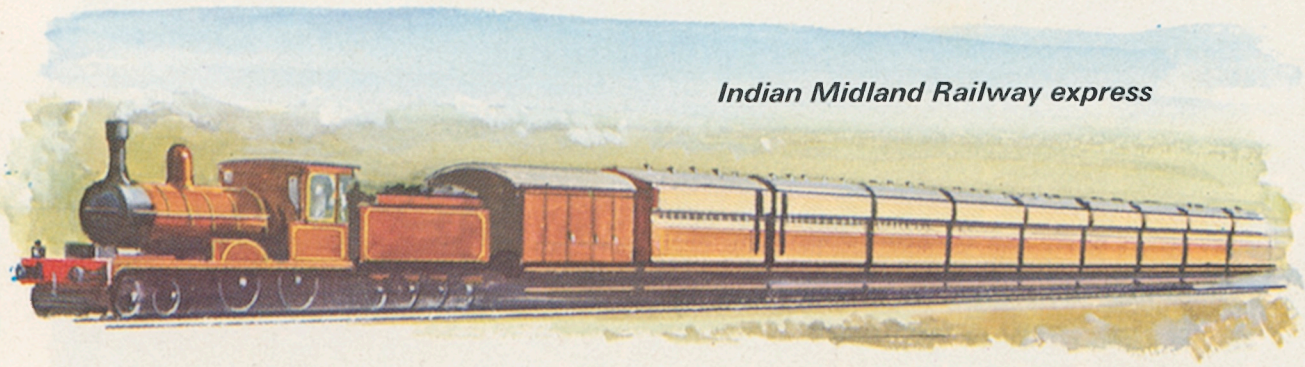


When the Union Pacific was first built, the line ran round the edge of the Great Salt Lake in Utah. Later on, a long trestle bridge and embankments, 31½ miles long, were built right across the lake. A large passenger train (left) is shown on this lake crossing, which has a double track. More and more double track sections and more powerful engines were introduced to speed up the journey.

Trains across the World

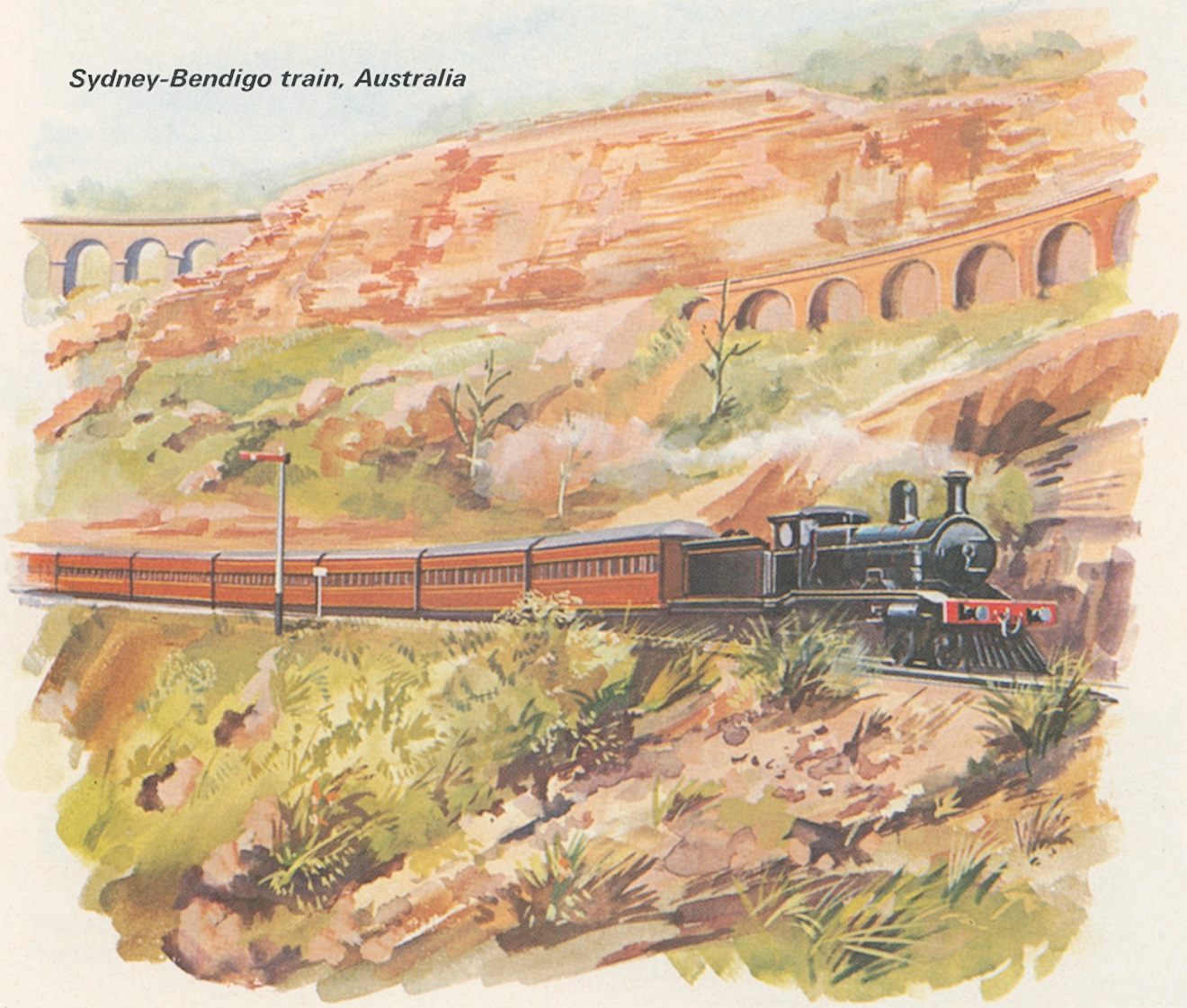
The 19th century Indian express (right) is typical of the stock used at the time. The Indian railway network, begun in 1852, was carefully planned in advance, and built in stages. It became one of the best in the British Empire. There were six principal systems on the 5 ft. 6 in. gauge, a metre gauge system of local lines and some even narrower gauge mountain railways.

Indian Midland Railway express



Sydney-Bendigo train, Australia

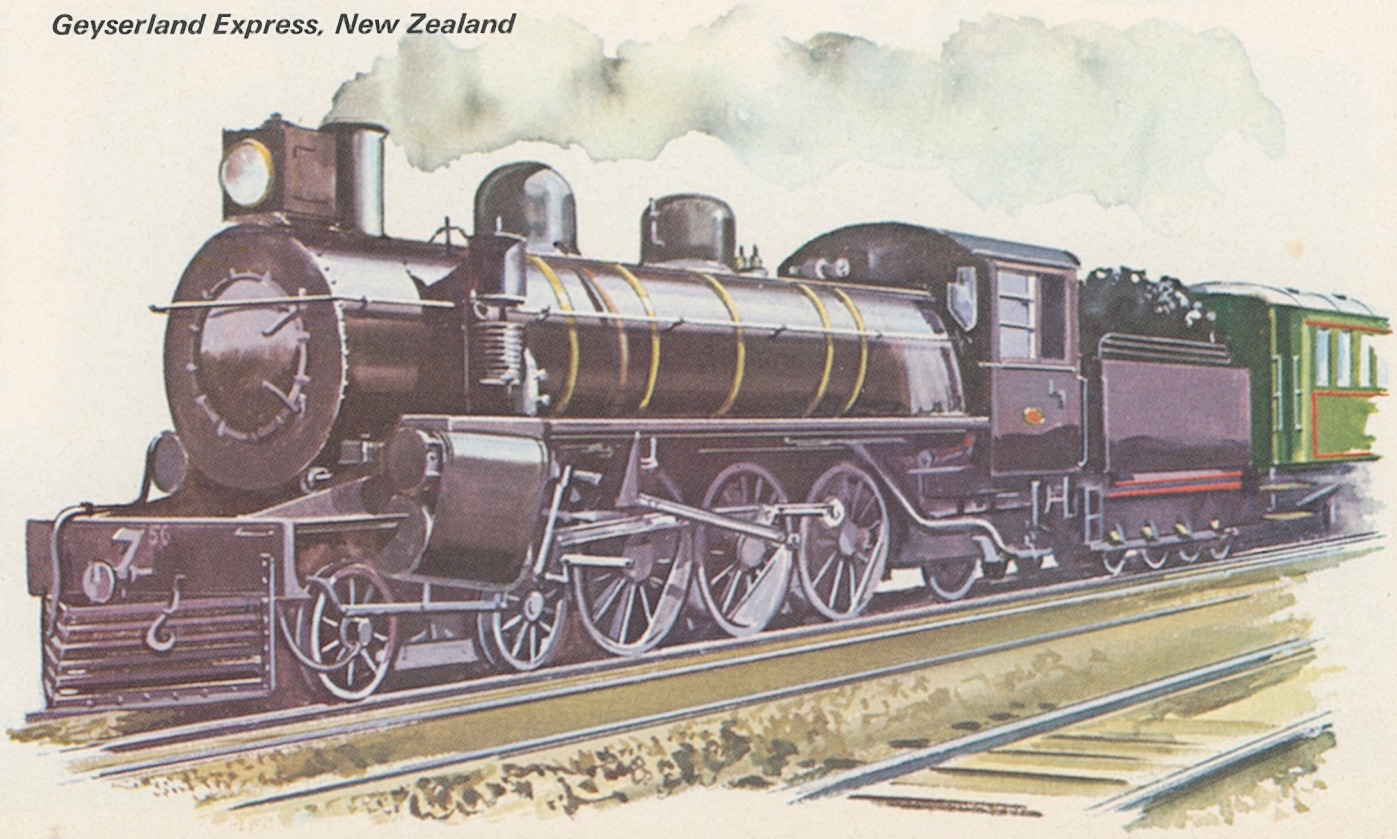
A Sydney-Bendigo train (right) at the turn of the century. The first railway in Australia was the Melbourne suburban line, begun in 1854. Here and all over the State of Victoria, the Irish gauge of 5 ft. 3 in. was used. The same gauge was used in South Australia, but other states adopted the standard 4 ft. 8½ in., making through-running impossible. In 1917, the last section of the first transcontinental link was built.



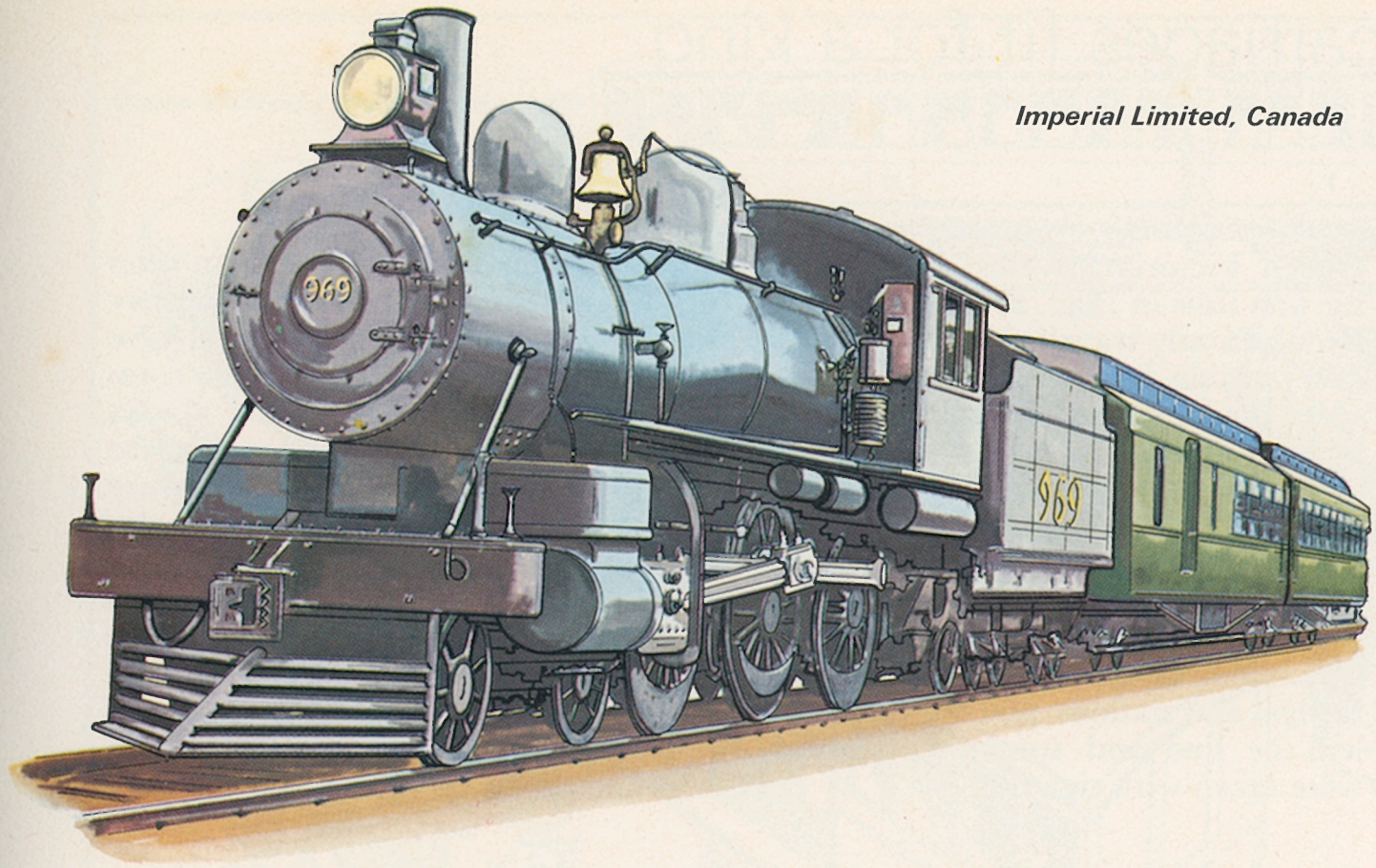
The two islands of New Zealand have two separate railway systems, but they are part of one organization. Both islands have very mountainous country, and both use 3 ft. 6 in. gauge. There are some magnificent tunnels and bridges. The steep gradients slow the trains down but communications are good.

The popular *Geyserland Express* on North Island (right) ran from Auckland to Totorura. It took many tourists to see the spectacular geysers in the region.

Geyserland Express, New Zealand

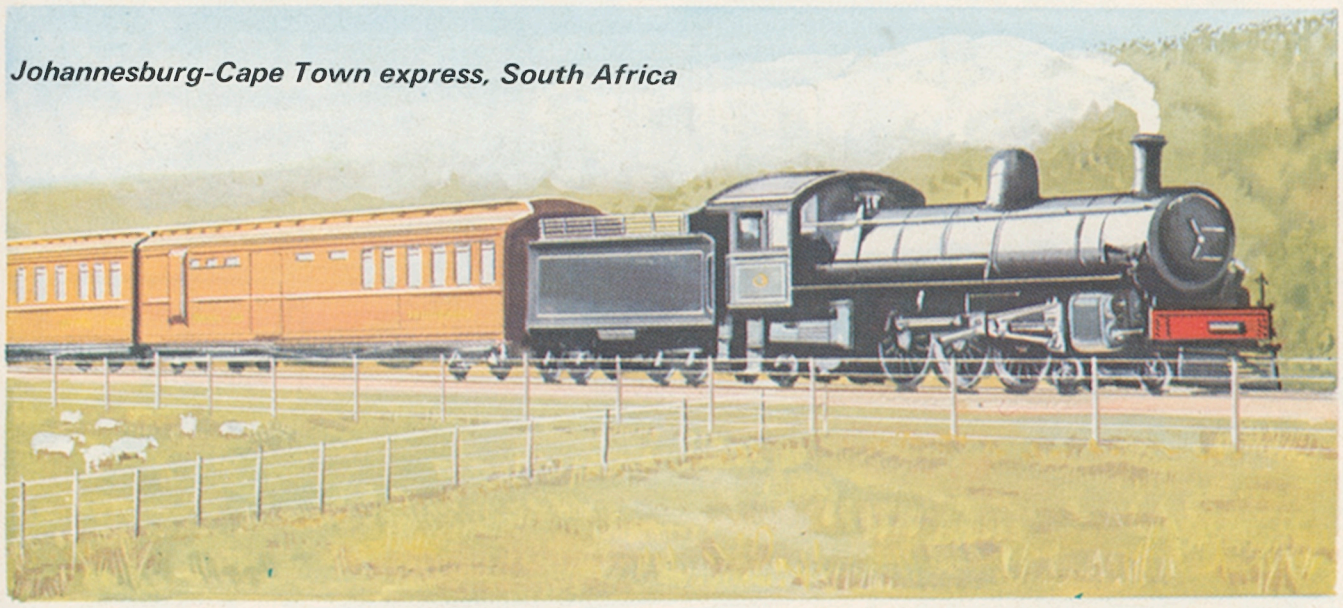


Imperial Limited, Canada



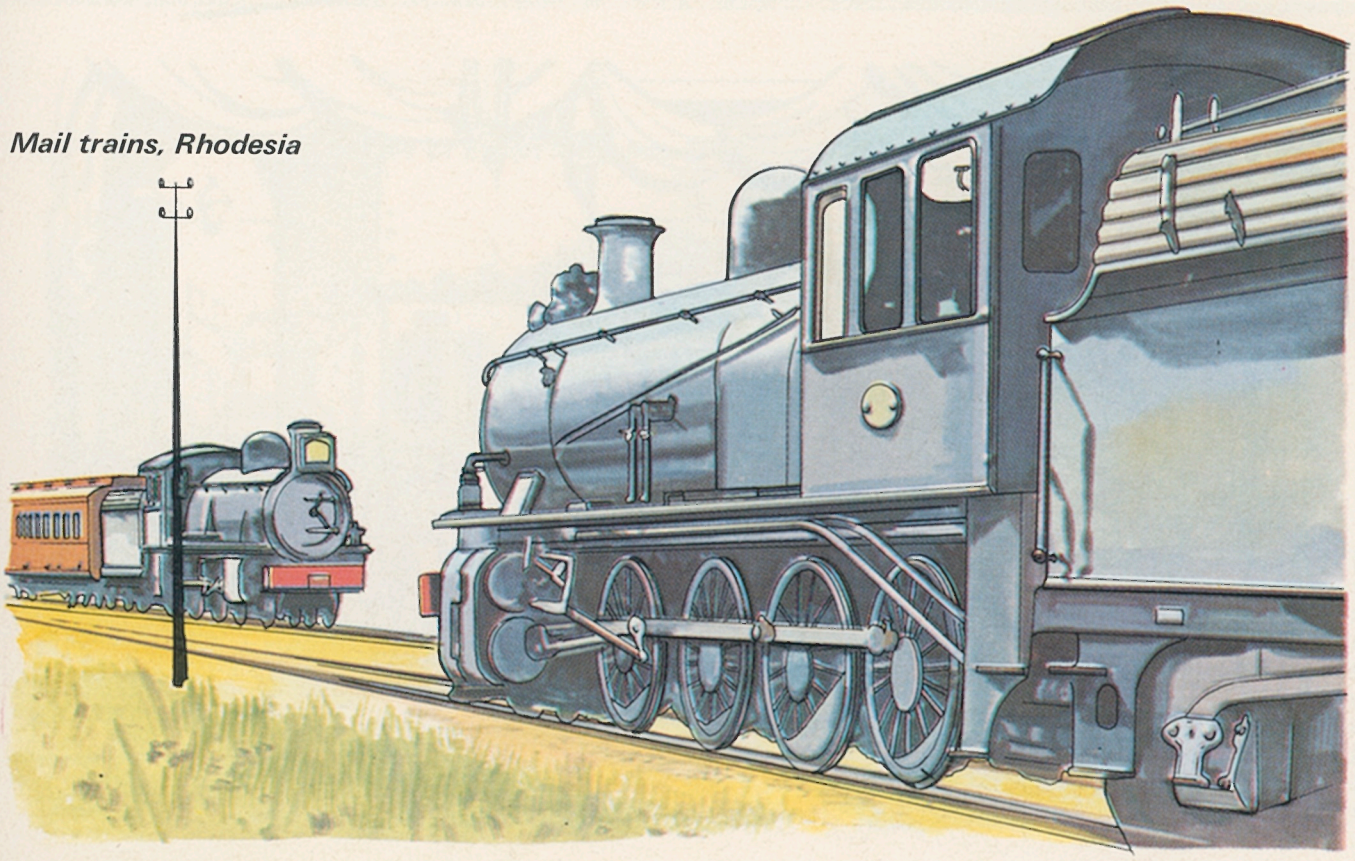
In 1900, one of the most famous trains was the *Imperial Limited* (left) of the Canadian Pacific. It took five days to cover the 3,000 miles from Montreal to Vancouver. Before the railway was built it took five months to cross Canada.

Johannesburg-Cape Town express, South Africa



The South African Railways began in 1859. There were two main lines, one from Cape Town to Kimberley, the other from Port Elizabeth to Johannesburg and Pretoria. The railways developed rapidly with the Kimberley diamond rush and also served the Witwatersrand goldfields which opened in 1886.

Mail trains, Rhodesia



The Rhodesian Railways were originally intended to be a part of a fantastic scheme to have a line right down Africa from north to south—the Cape to Cairo Railway.

The two mail trains (left) are on a passing loop on a single main line.

One of the most magnificent views from a train in Rhodesia is of the Victoria Falls which are spanned by a bridge 420 ft. high.

Royal trains carriages fit for a king

Lavatory with padded upholstery for the use of royal passengers.

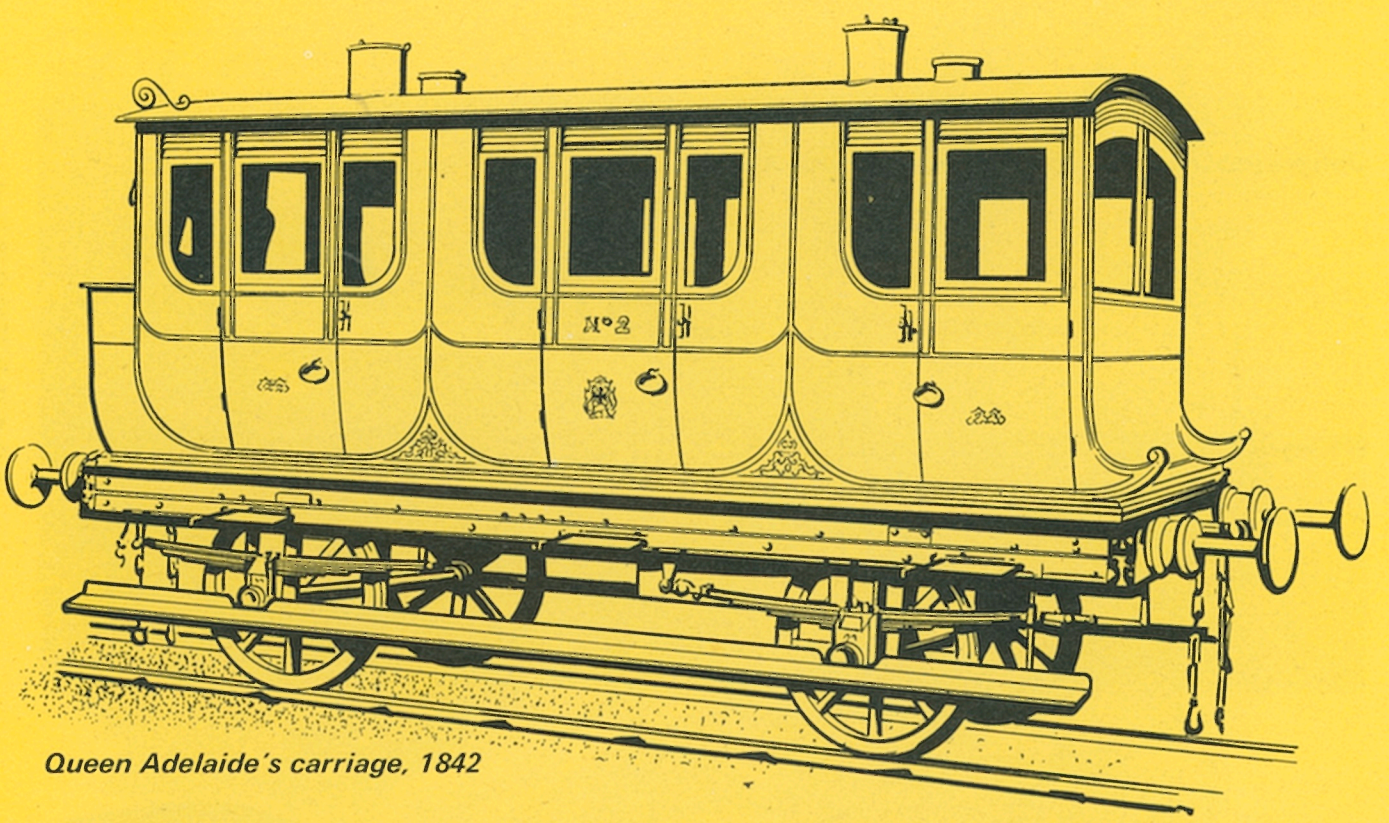
Queen Victoria travelled by train for the first time in 1842. From then on the Royal Family travelled by train whenever possible, but the Queen did not like speed and objected to going at more than 40 m.p.h.

Special safety precautions were taken for royal trains. All movements on the line were stopped by a pilot engine which ran a quarter of an hour ahead of the royal train. Points were padlocked, watchmen were posted at all crossings, bridges and stations, platelayers patrolled the line and special precautions were taken with signalling.

In Britain, royalty pay their fares just like other passengers. They also pay for the use of the special trains that have been built for them by the railway companies. The Royal Family are always consulted about the fittings for the interior. King Edward VII said "Make it like a yacht". There were also carriages kept at Calais for British royalty travelling abroad. King George V had to spend so much time on his train during the 1914–18 war that he had baths fitted.

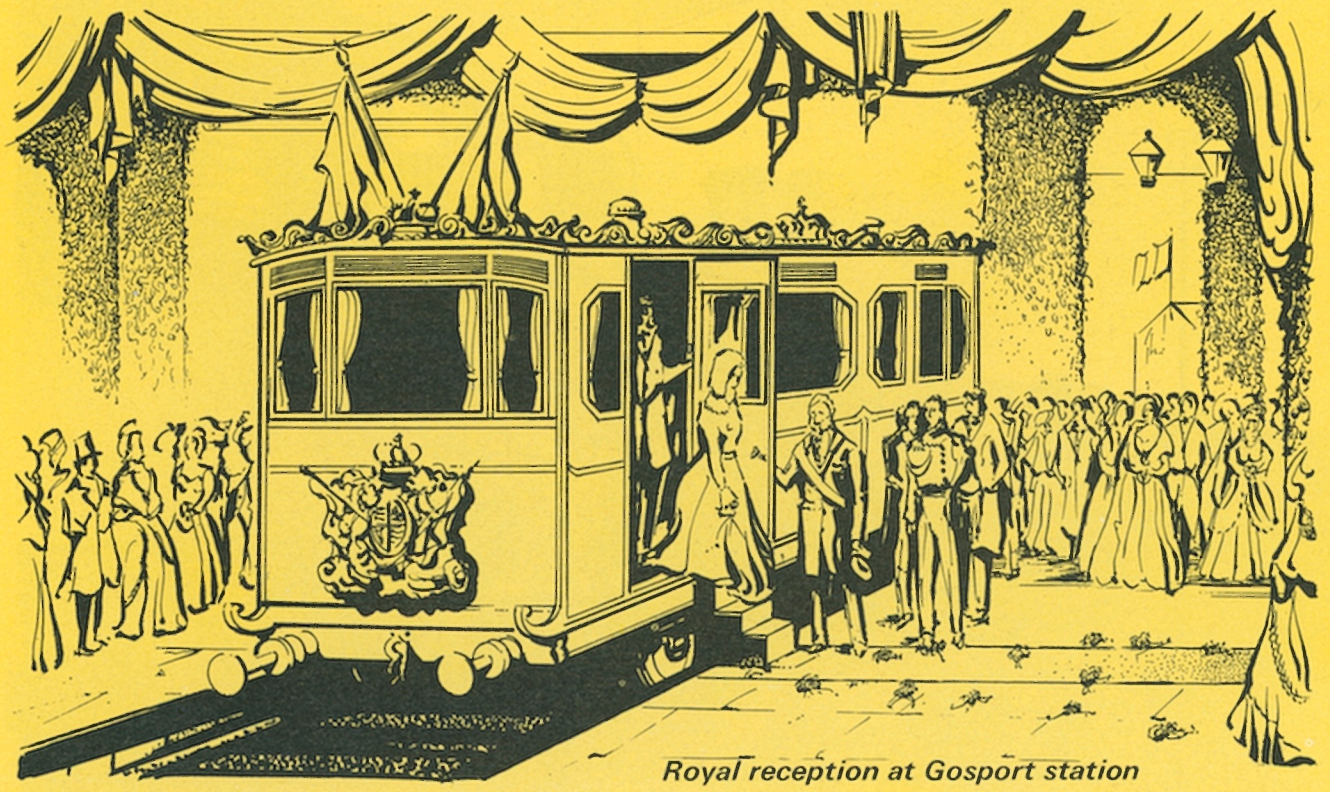
Foreign monarchs and aristocrats had fine private trains too.

In 1842 the London and Birmingham railway built a special carriage (right) for Queen Adelaide, the widow of King William IV. It was a four-wheeled carriage with two compartments and a coupé for attendants. Rail travel was not very comfortable in the early days, even for a queen. On Queen Adelaide's train there was no heating, only footwarmers. There were only two oil lamps. There were no brakes on the carriage, but it did have spring buffers and gold-plated hand-rails and door-handles. The queen could sleep with her feet in the "boot" shown on the left.



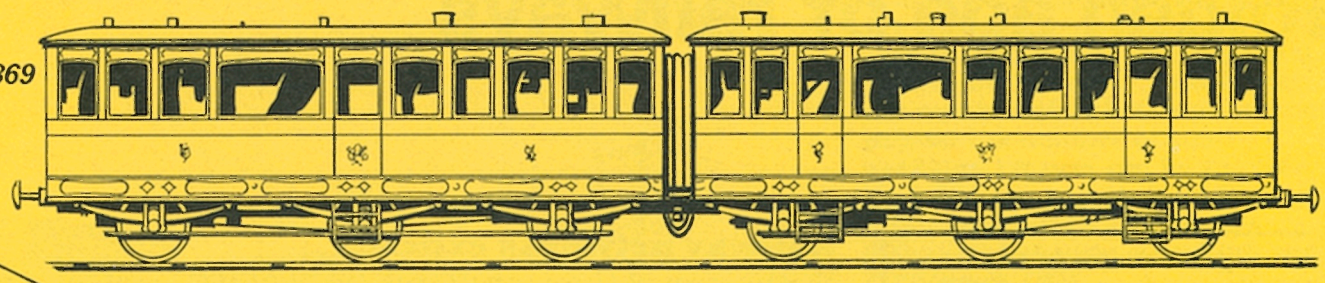
Queen Adelaide's carriage, 1842

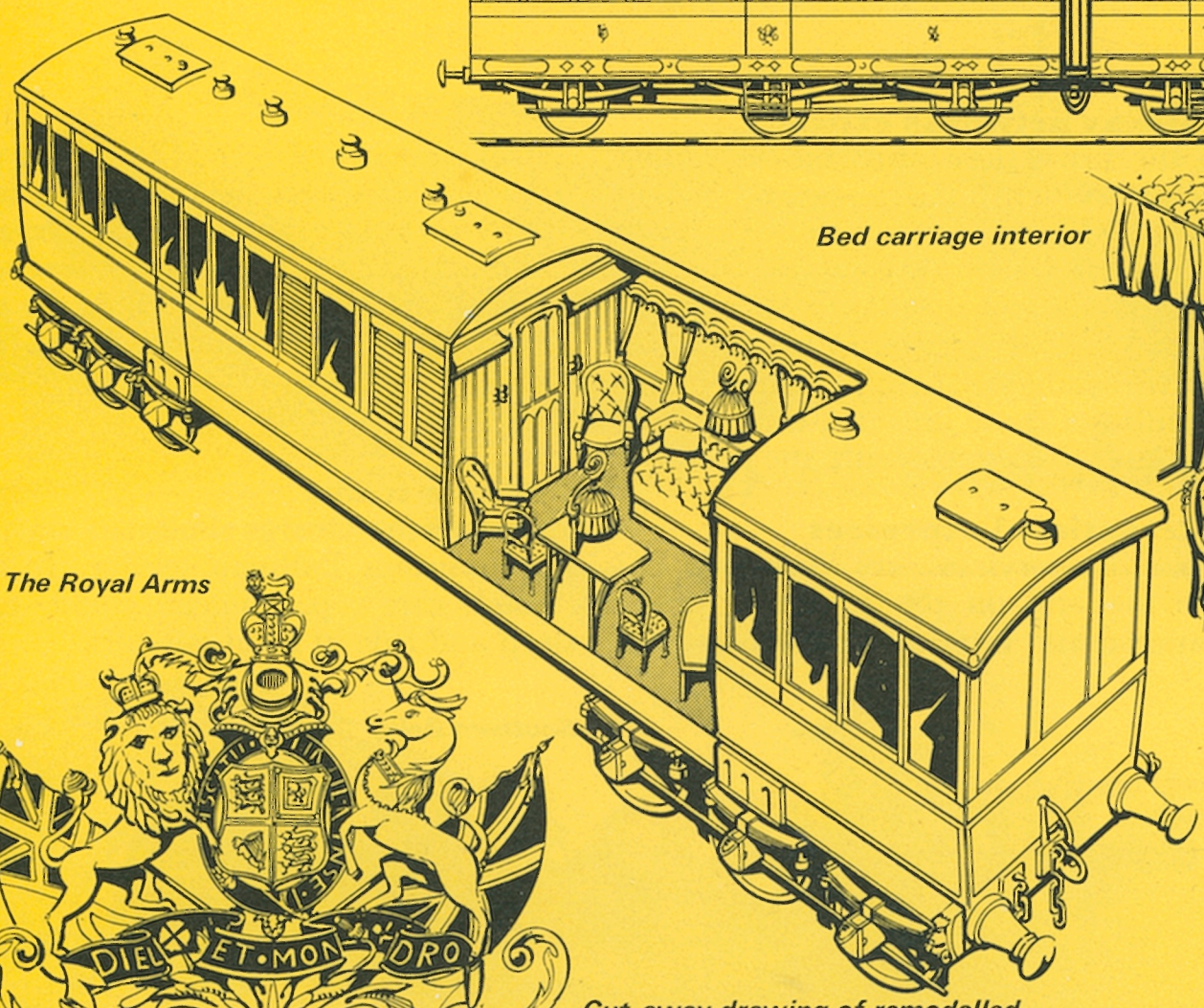
When King Louis Philippe of France was on a state visit to Britain a railway carriage was used for the royal reception (right) at the station at Gosport, where he was greeted by Queen Victoria and Prince Albert. At the request of his government the King never travelled by train in France. They were concerned for his safety after there had been a severe rail accident at Meudon, near Paris.



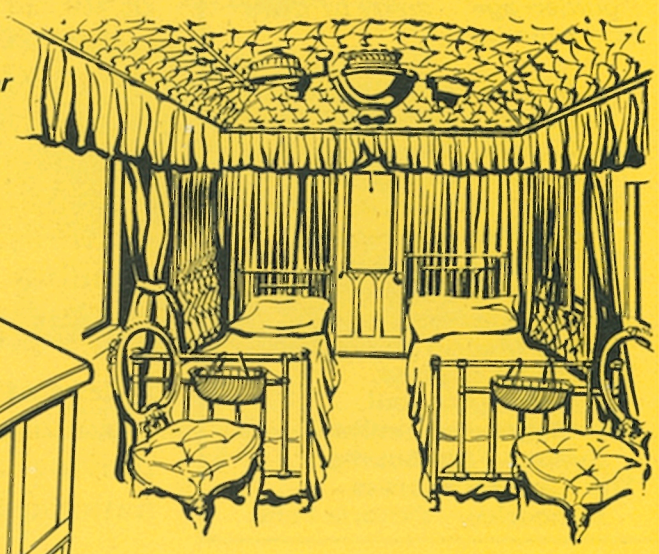
Royal reception at Gosport station

Queen Victoria's royal saloons, 1869





Bed carriage interior

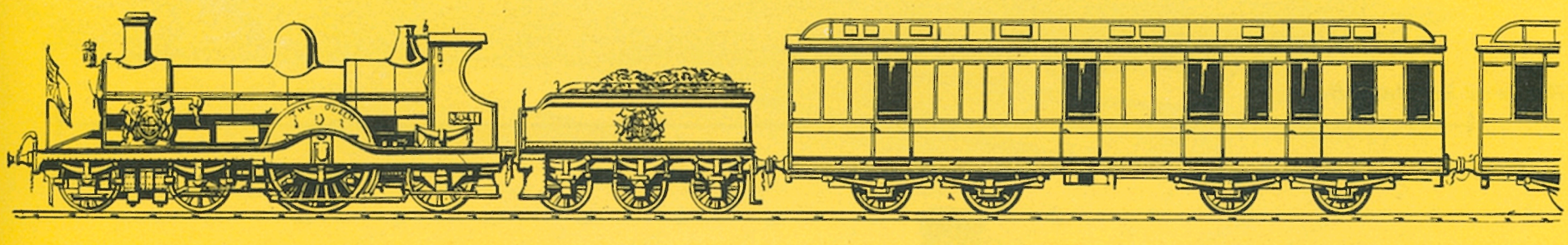


The Royal Arms

Cut-away drawing of remodelled royal saloon

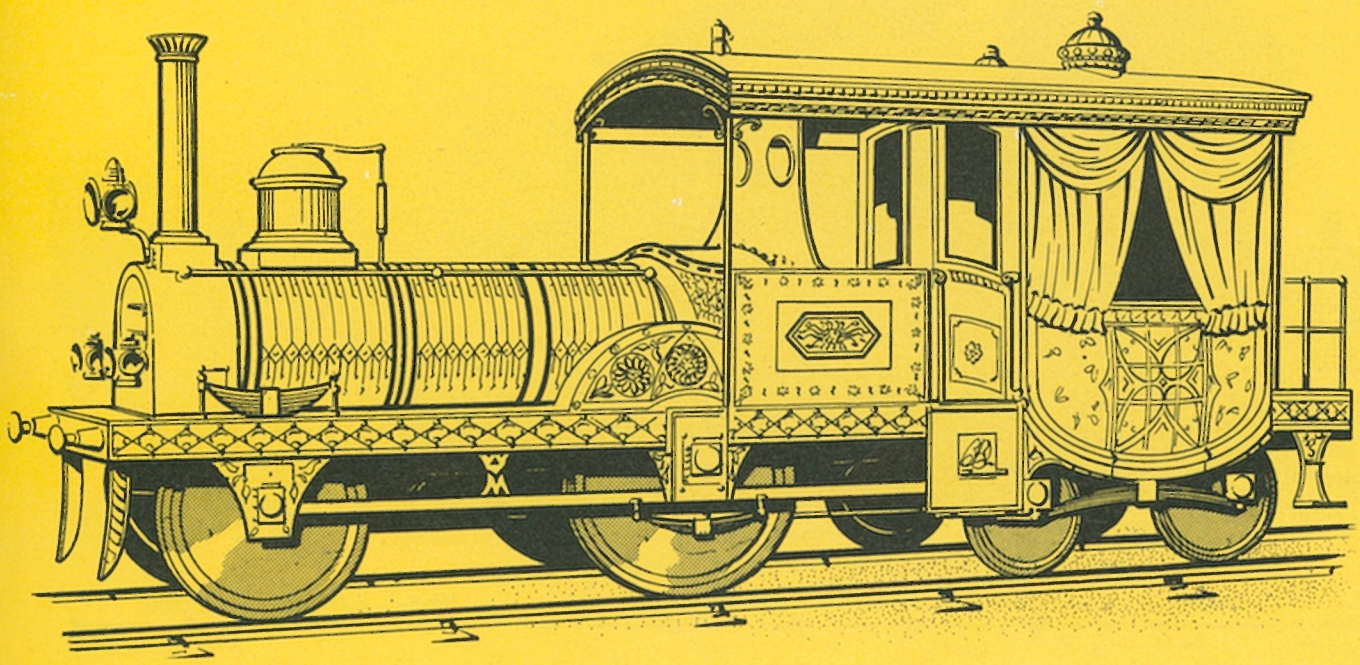
In 1869 the London and North Western built a pair of royal saloons (top) especially for the royal train. They were permanently close-coupled and connected by a flexible covered footway. In 1895 the two coaches were joined on a long 12-wheeled underframe. The bedroom is shown above.

The Queen, 1897



Queen Victoria travelled by train (above) from Windsor to London on the occasion of her Diamond Jubilee in 1897. The engine is one of the Great Western "singles", *The Queen,* specially decorated and flying the Royal Standard.

The Khedive of Egypt's engine, 1859



This remarkable vehicle (left) was built for the Khedive of Egypt in 1859 by Robert Stephenson. The engine and passenger compartment are all on the same frame. It was built to the standard gauge and ran on the Egyptian State Railways. It was lavishly and expensively decorated but although the line was unfenced there was no cowcatcher.

Golden age of railways

Some great trains of the "golden age", many of them still running.

The Empire State Express,
New York—Buffalo.
The Cornish Riviera Express,
London—Penzance.
The International Limited,
Montreal—Chicago.
The Côte d'Azur Express,
Paris—the Riviera.
The Sud Express,
Paris-Madrid and Lisbon.
The Orient Express,
Ostend—Istanbul.
The Melbourne Limited,
Sydney—Melbourne.
The Zambesi Express,
Kimberley—Victoria Falls.

Railway networks expand

By the turn of the century the expanding railway systems linked towns and villages that had previously had very poor communications. In England virtually no village was more than 12 miles away from a railway station to which horse-drawn carriers took traffic. Later, motor omnibuses came into use, first to feed, but later to compete with, the railways.

International expresses

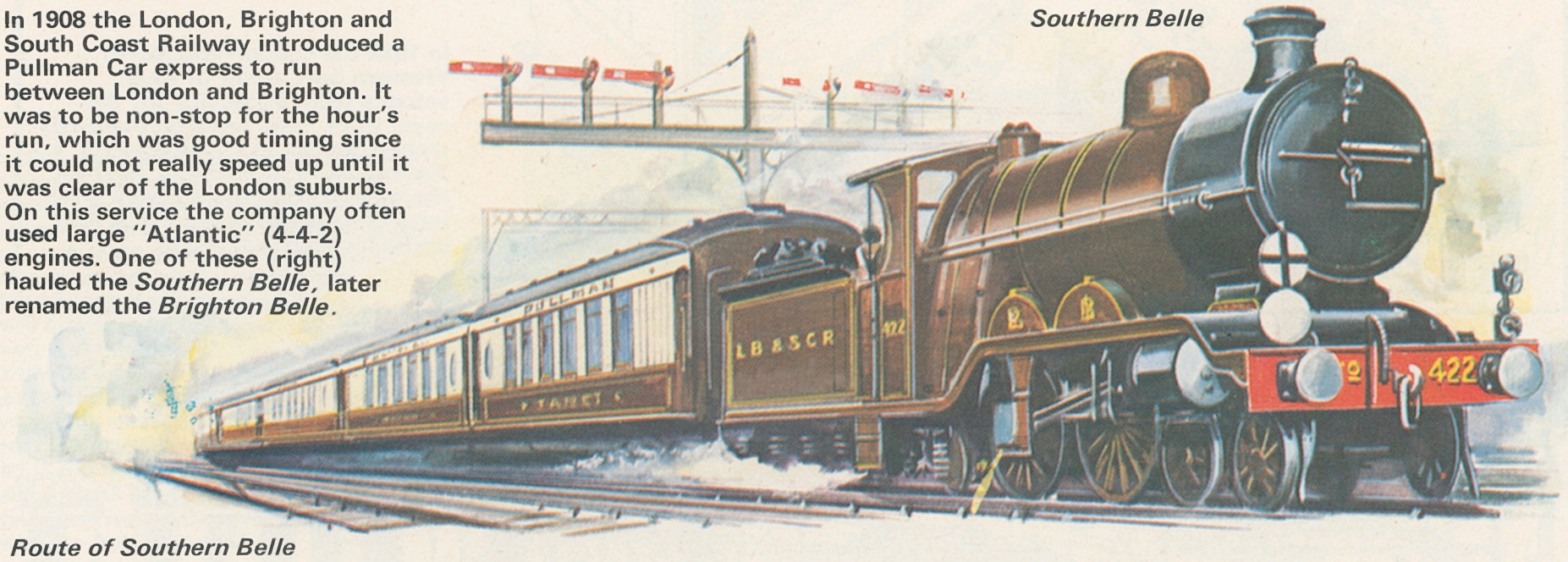
Main line services were constantly improving and on the continent many national and international express services were introduced. The dining and sleeping carriages belonged to a company with the grand name of *Compagnie Internationale des Wagons-Lits et des Grands Express Européens*. They could be seen everywhere from France to China. Passengers could travel right across two continents by train.

Pullman trains

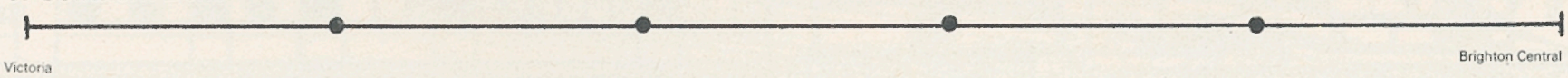
In America, George Pullman started the luxurious Pullman service. In his "hotel cars" passengers could eat, sleep and ride in great comfort.

In 1908 the London, Brighton and South Coast Railway introduced a Pullman Car express to run between London and Brighton. It was to be non-stop for the hour's run, which was good timing since it could not really speed up until it was clear of the London suburbs. On this service the company often used large "Atlantic" (4-4-2) engines. One of these (right) hauled the *Southern Belle*, later renamed the *Brighton Belle*.

Southern Belle

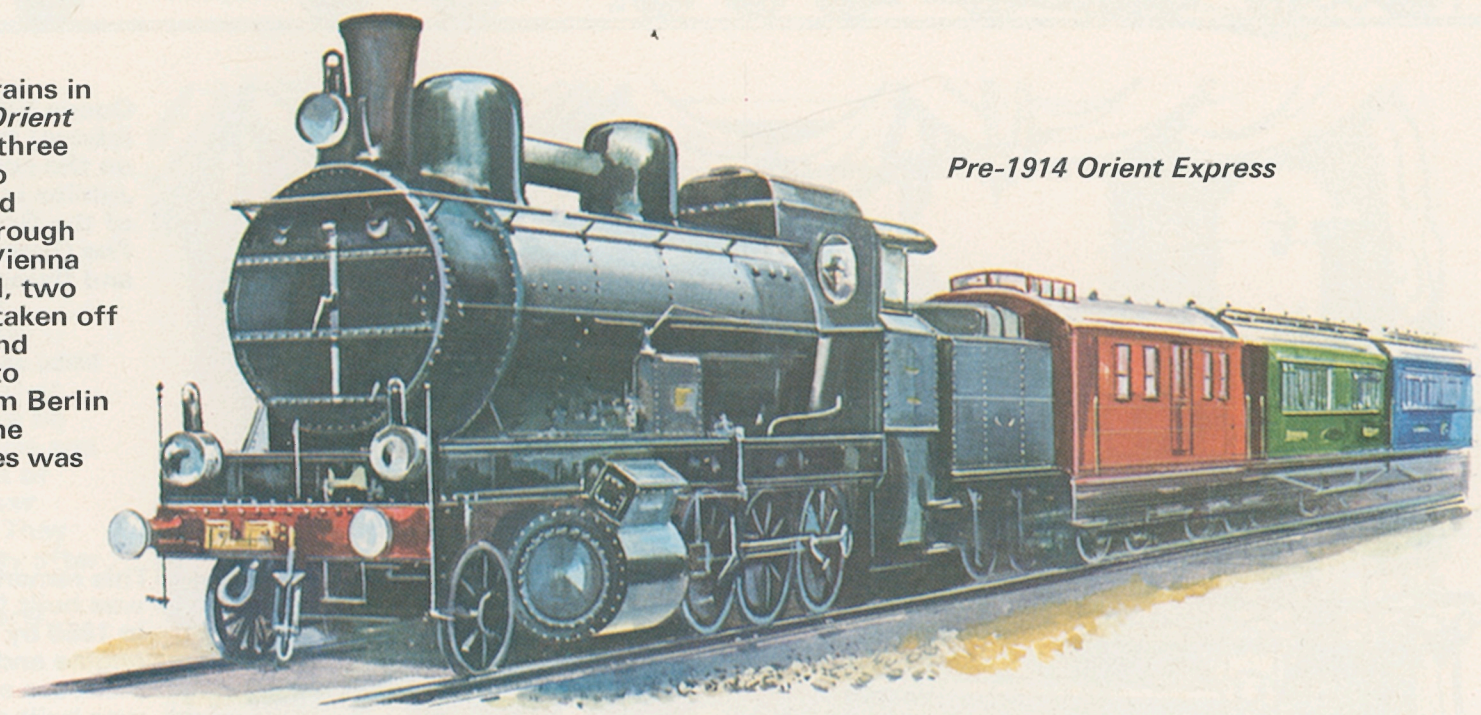


Route of Southern Belle

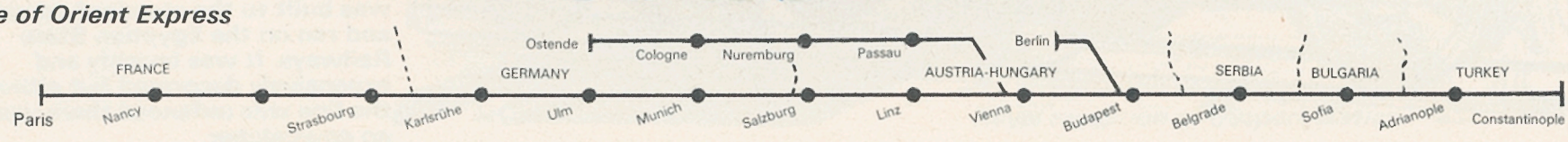


One of the most famous trains in Europe was the pre-1914 *Orient Express* (right) which ran three times a week from Paris to Constantinople (now called Istanbul). The route lay through Germany and Austria. At Vienna the train was remarshalled, two coaches from Paris being taken off and two others from Ostend added. The train went on to Hungary and a sleeper from Berlin was added at Budapest. The schedule for the 1,750 miles was 65 hours.

Pre-1914 Orient Express



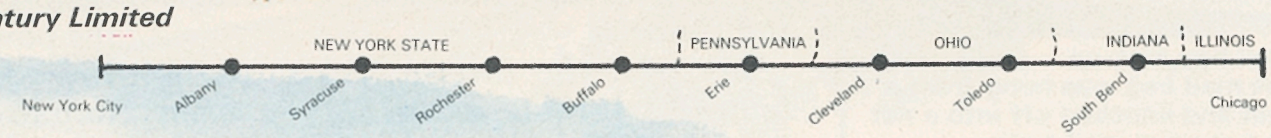
Route of Orient Express

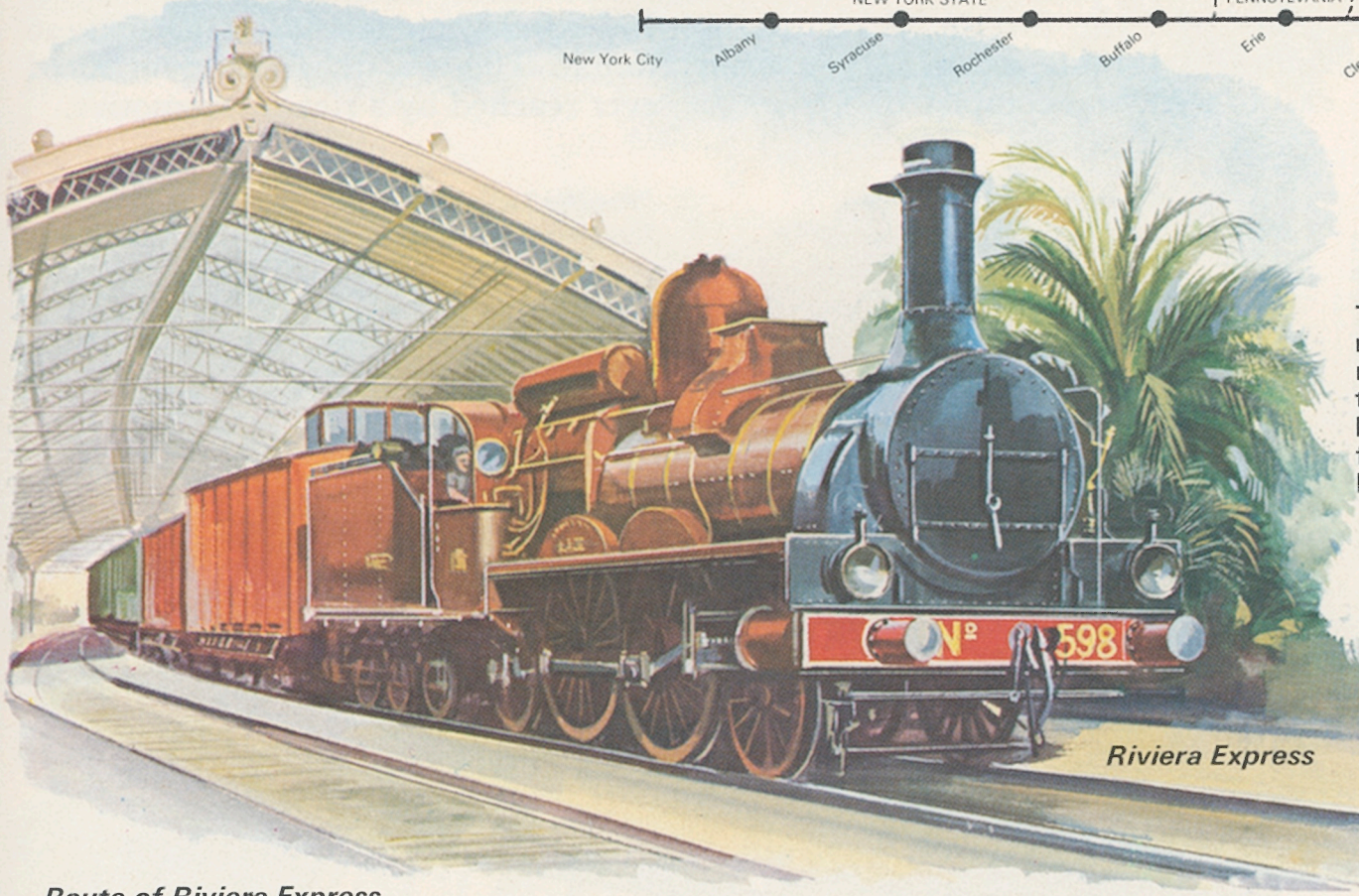


Twentieth Century Limited

One of the most famous trains in the United States was the *Twentieth Century Limited* (left). (The word "limited" meant that the number of tickets sold did not exceed the number of seats available.) It was run by the New York Central and Hudson River Rail Road, and began running the 980 miles between New York and Chicago in 1902.

Route of Twentieth Century Limited

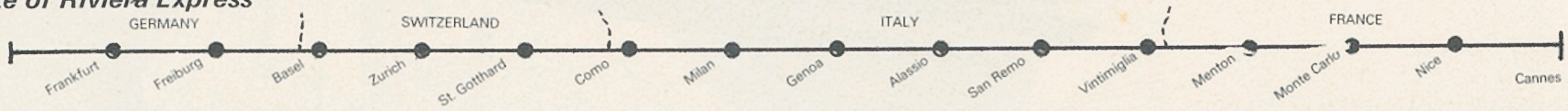




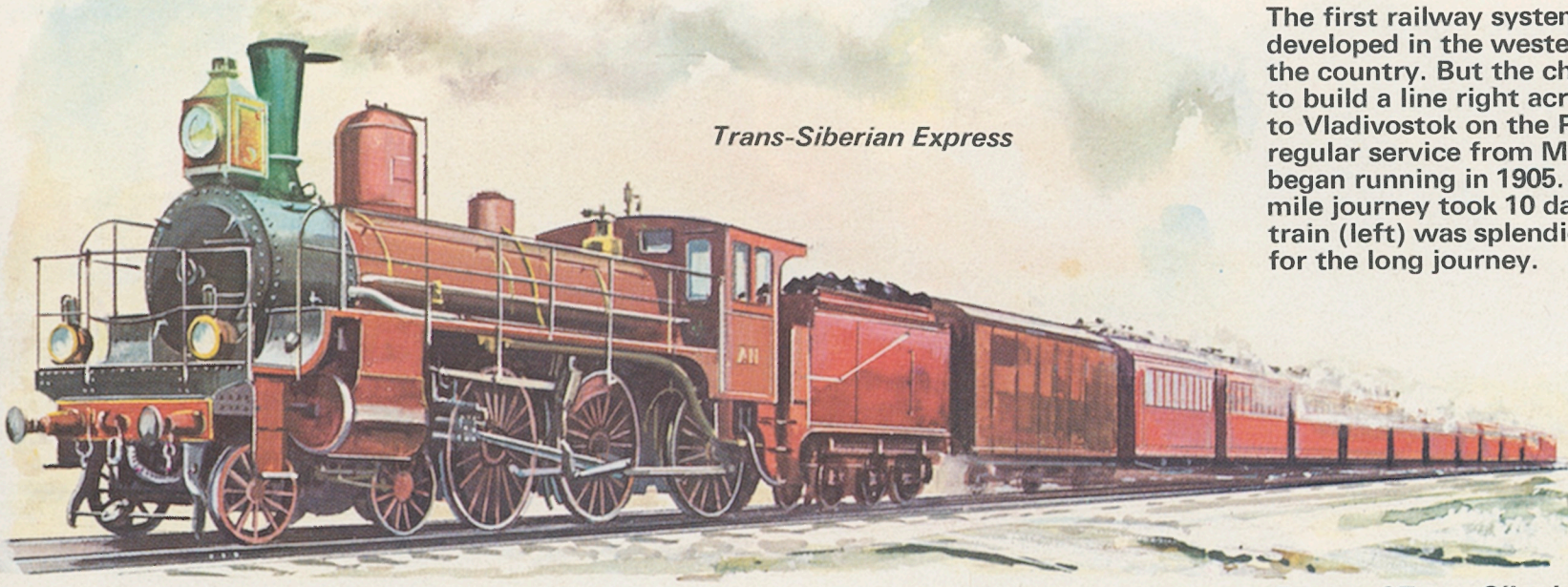
Riviera Express

The luxurious *Riviera Express* (left) ran from Berlin to the Mediterranean, taking northern Europeans to the popular resorts on that beautiful coast. The train went from Germany through Switzerland to Italy and on to France.

Route of Riviera Express

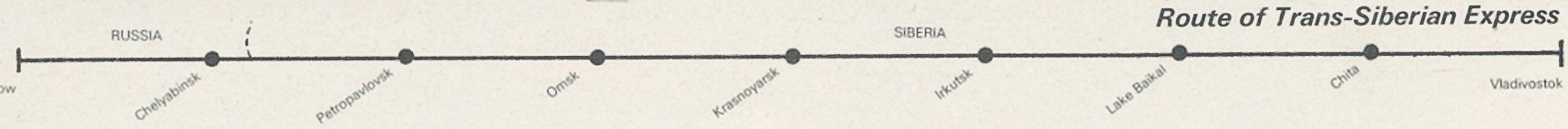


Trans-Siberian Express

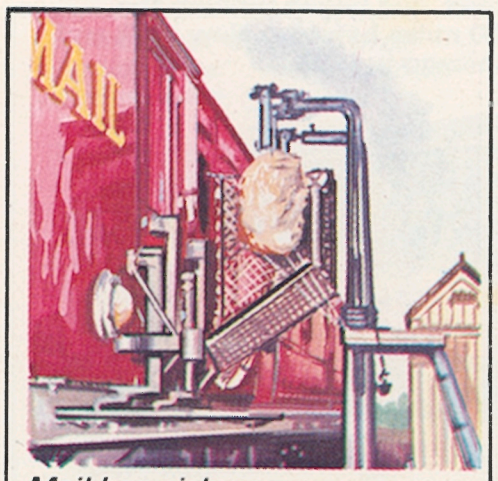


The first railway systems in Russia developed in the western part of the country. But the challenge was to build a line right across Siberia to Vladivostok on the Pacific. A regular service from Moscow began running in 1905. The 5,000-mile journey took 10 days. The train (left) was splendidly equipped for the long journey.

Route of Trans-Siberian Express



Railways between the wars



Mail bag pick-up
The mail bag was hung from a post and knocked off into a net by a passing mail train.

At the end of World War I in 1918 there was much damage to put right on the railways in many countries. This was an opportunity to develop and modernise the systems. Those countries that had a good supply of hydroelectric power, but little coal—such as Italy, Sweden and Switzerland—began electrification of the main lines.

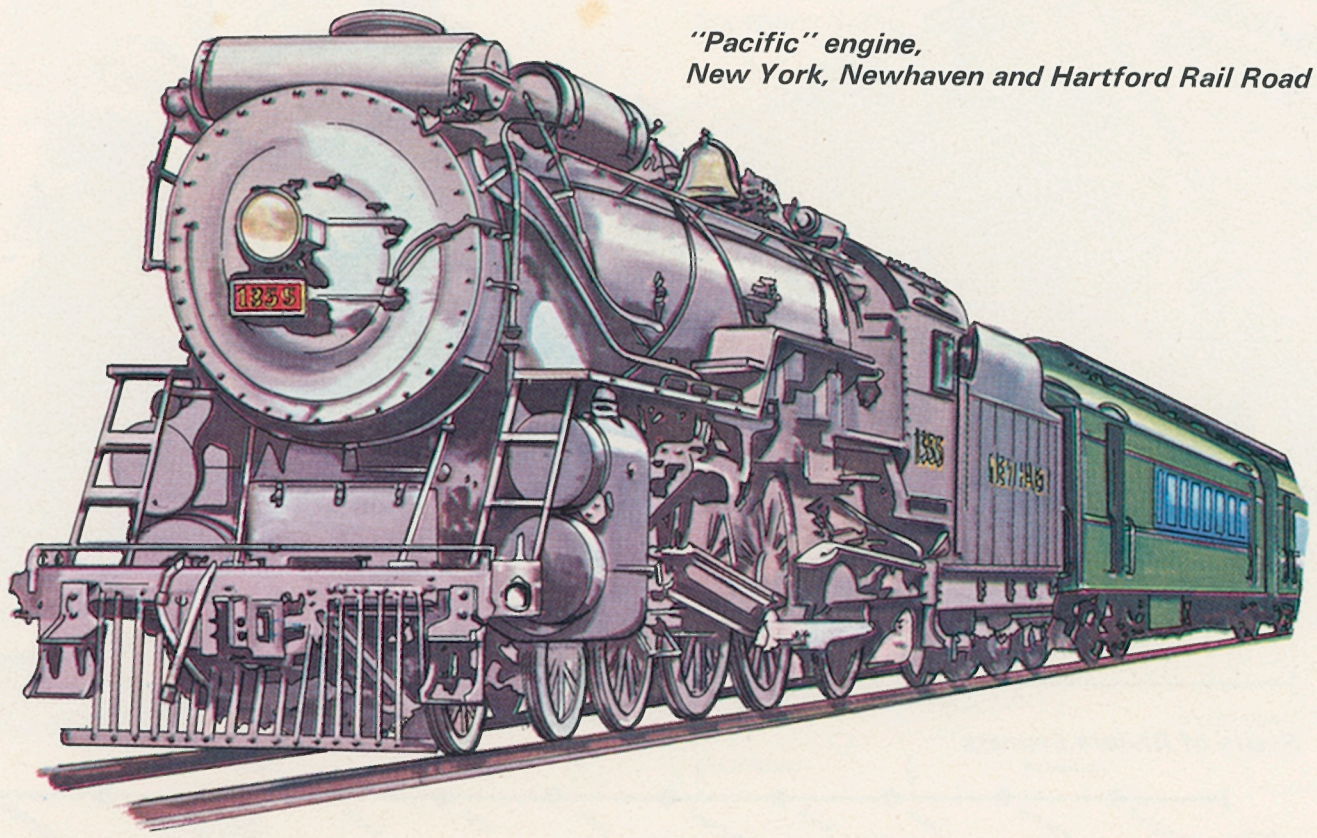
Many routes were opened or improved with the building of new bridges and tunnels.

In 1931, the first unbroken transcontinental route across Africa from east to west, was completed.

New types of engine

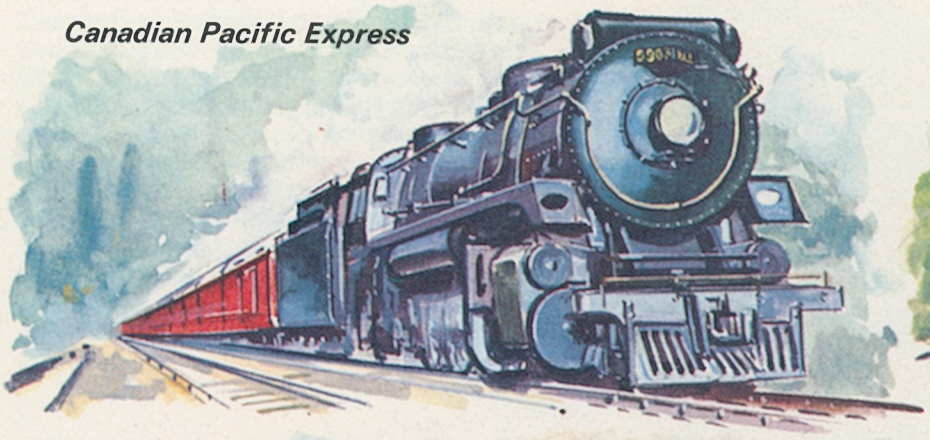
Many new and powerful engines were designed to provide fast modern services. In Denmark the first diesel engines were developed in 1929 and in the 30's diesel railcars were providing regular services in the U.S. In 1932 a very powerful turbine locomotive came into use for hauling the heavy iron ore trains in Sweden. In Britain, new classes of steam engine were introduced, including the powerful "Pacific" types of the 30's. In 1938 the engine *Mallard* reached 126 m.p.h. This was the maximum speed ever reached by a steam locomotive.

"Pacific" engine,
New York, Newhaven and Hartford Rail Road

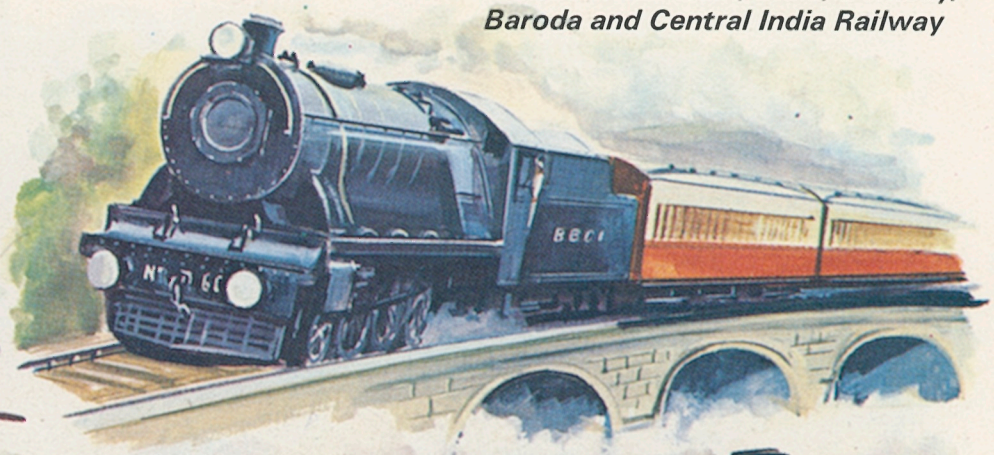


In 1929, powerful "Pacific" (4-6-2) engines were used on the New York, New Haven and Hartford Rail Road which runs along the beautiful New England coast (right). In the 30's diesel-hauled services began in the United States.

Canadian Pacific Express



Frontier Mail train, India, Bombay, Baroda and Central India Railway



Cornish Riviera Express, Great Western Railway

Flying Scotsman, London and North Eastern Railway

Rheingold Express

One of the most luxurious German passenger trains was the *Rheingold Express* (left). It was run by the Mitropa Company which was the German equivalent of the Wagons Lits and Pullman services. This particular engine was a Bavarian "Pacific".

In 1933 the German State Railway started a fast inter-city service with two-car diesel units. The first train was called the *Flying Hamburger.*

Flèche d'Or, 1926

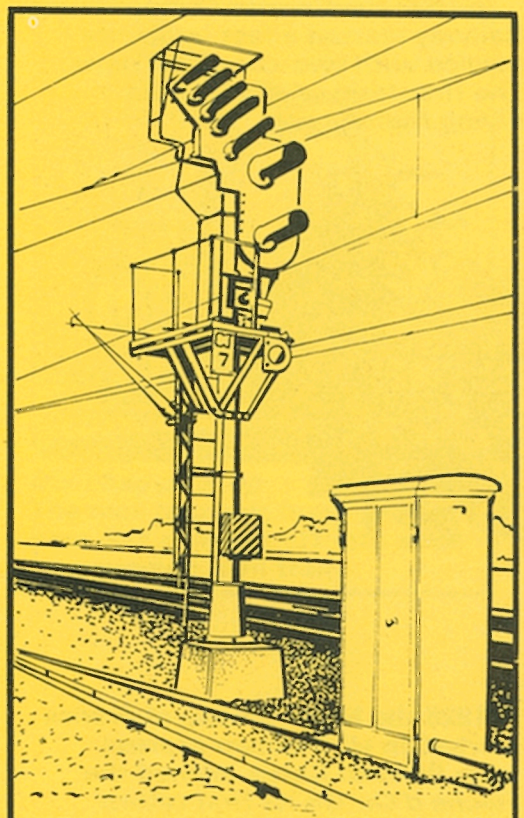
In 1926 the Nord railway of France started an all-Pullman express from Paris to Calais, named the *Flèche d'Or.* On its first return trip, passengers from Dover crossed to Calais on the steamer *Isle of Thanet* (left).

In 1929 a new service from London to Paris began, the *Golden Arrow—Flèche d'Or.* A special ship, *Canterbury,* was built for the channel crossing.

In 1937 King George VI was crowned and a new high speed express, *The Coronation Scot,* was introduced between London and Glasgow. Special streamlined, futuristic-looking "Pacific" engines were built for the new train which was given a journey time of $6\frac{1}{2}$ hours including a call at Carlisle. On test, the 158 miles from Crewe to Euston were covered in 119 minutes, giving an average speed of nearly 80 m.p.h. On one run it reached a maximum speed of 114 m.p.h.

Coronation Scot, 1937

Diesel and electric trains



Four-aspect colour light signal with junction indicator

Diesel locomotives

The main change that has come over the world's railways since 1950 has been the disappearance of the steam locomotive except from "museum" lines. The main reason for this change is that men are no longer willing to do the hard, dirty work of driving and maintaining the steam engines.

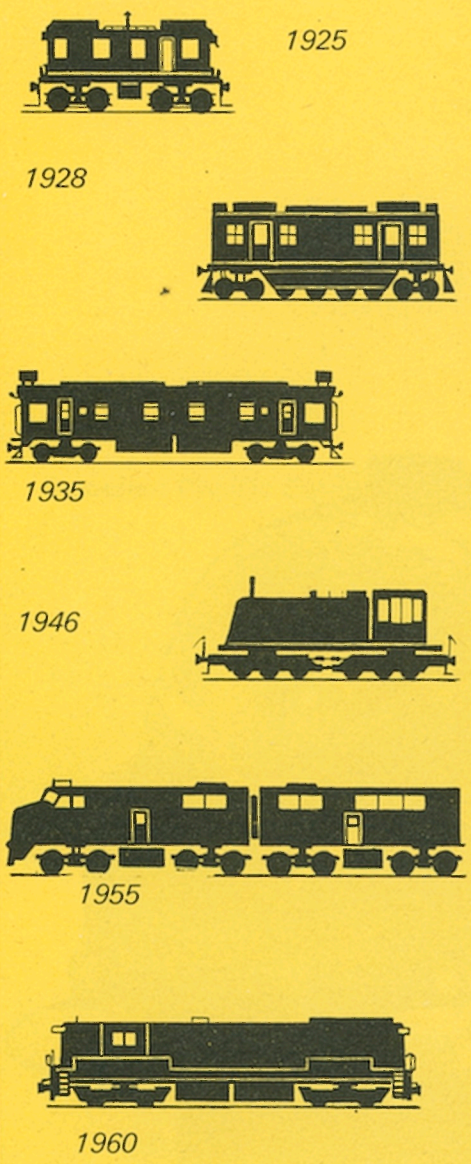
There are two alternatives to steam traction. One is the use of "internal combustion" engines of the same family as those which drive cars and so on; these are almost always of the diesel type. To get the power from the engine to the wheels, though, it may be turned into electricity in the locomotive itself. Such "diesel electric" transmission allows good control over power and speed.

Electrification

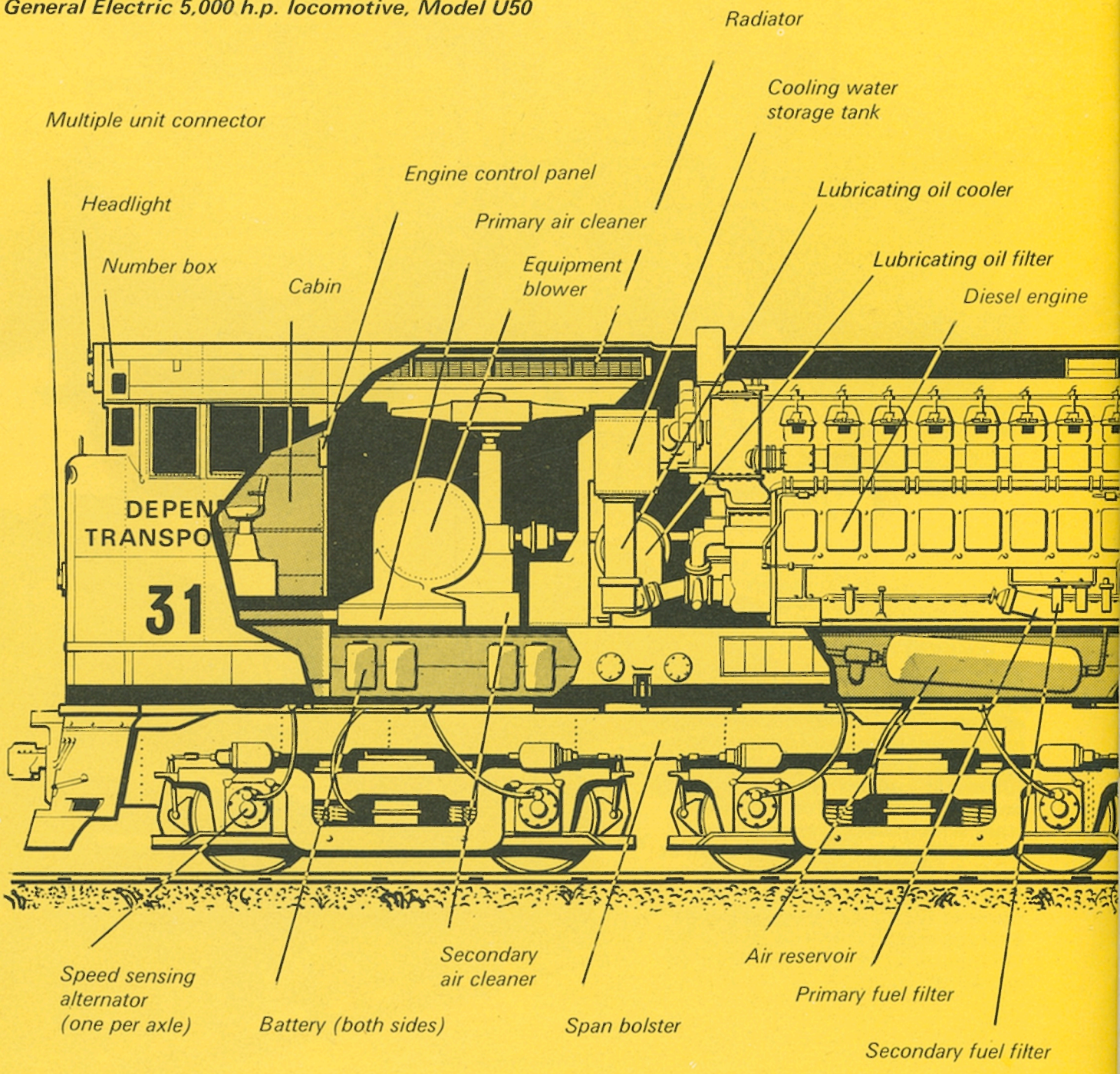
It is expensive to electrify a railway because overhead wires and transformers are needed. So it is only practical where a line is very busy, or carries heavy traffic. Under such conditions, electricity permits cheap running at high speeds, for an electric engine produces high acceleration. Electricity is also a clean power source.

For both diesel and electric trains, there is an alternative to the usual locomotive, or "all in one" railcar. This is the "multiple unit", which distributes the driving motors all along the train. Small blocks of carriages can propel themselves, so the system is very useful in making up a suburban train which might need twelve cars at rush-hour, but only six at other times.

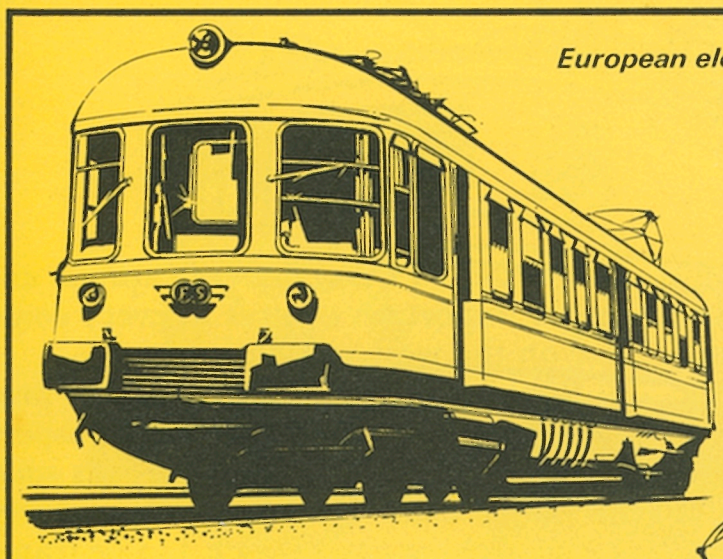
The development of diesel locomotives



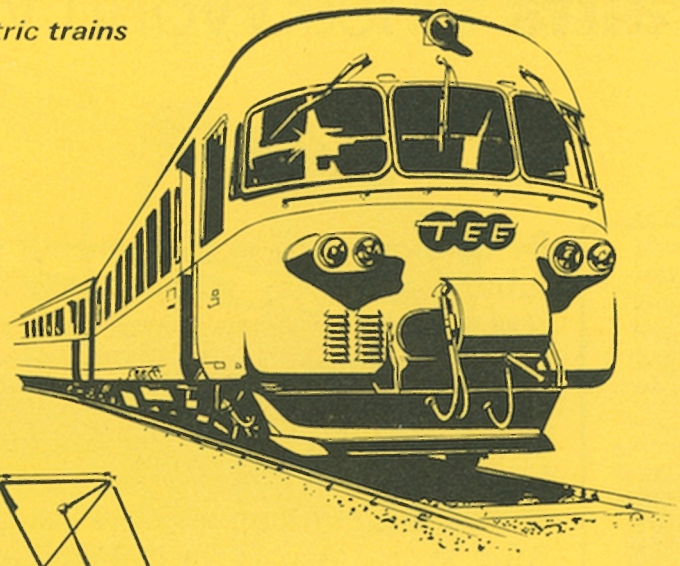
General Electric 5,000 h.p. locomotive, Model U50



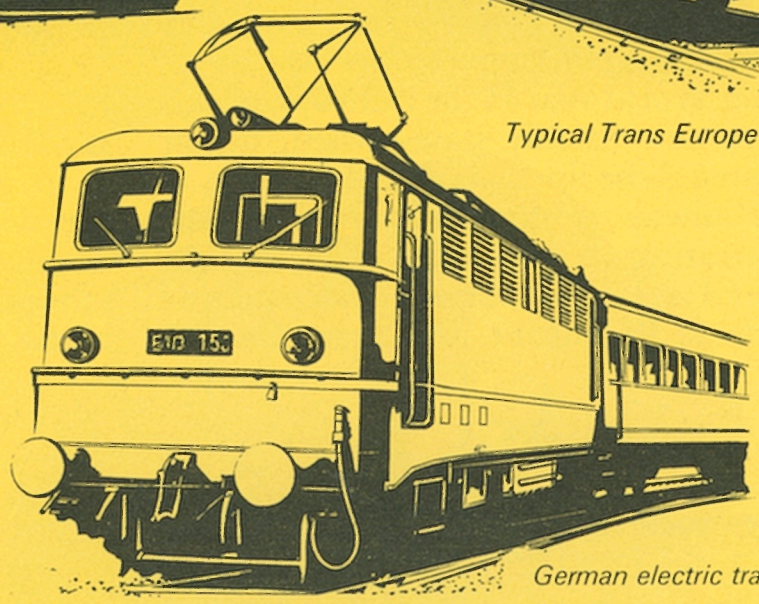
European electric trains



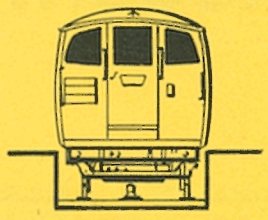
Italian State Railways



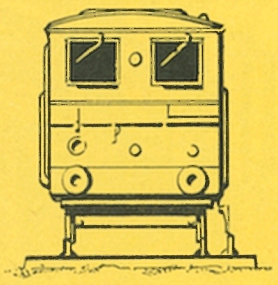
Typical Trans Europe Express



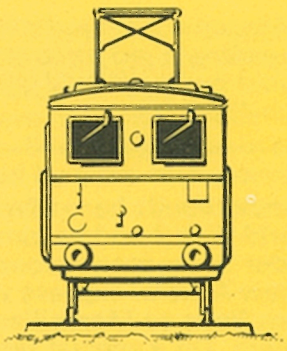
German electric train



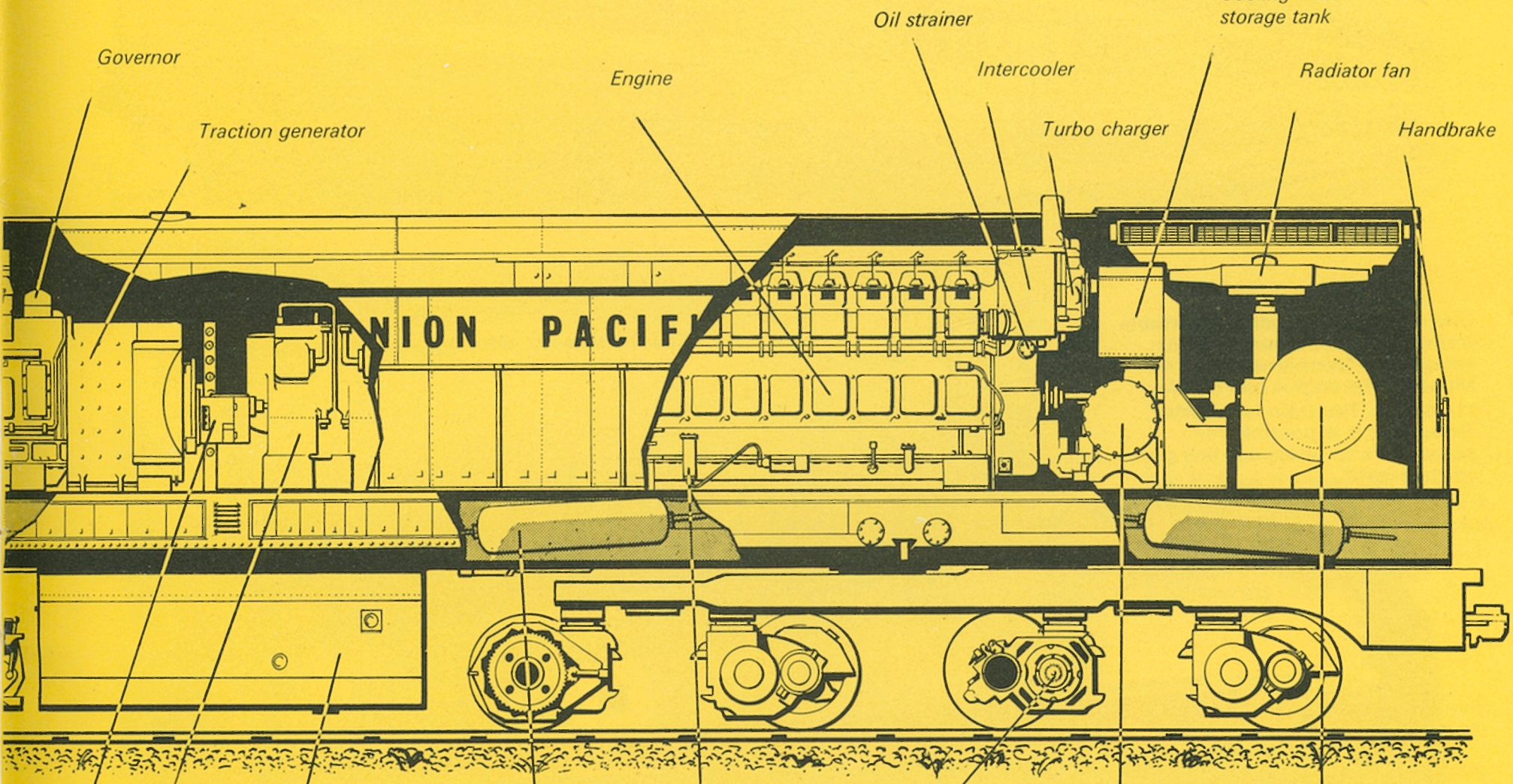
Centre pick-up



Side pick-up



Overhead pick-up



Modern trains since World War II

Moscow's magnificent underground railway, opened just before World War II, in 1938

By the beginning of this century many suburban railway services were being replaced by electric trams and motor buses. Passenger traffic declined as the number of private motor cars increased. Lorries were transporting freight that had previously gone by rail, and later air transport brought more competition. After World War II the railways, which were now usually state-owned, began closing those lines which did not pay.

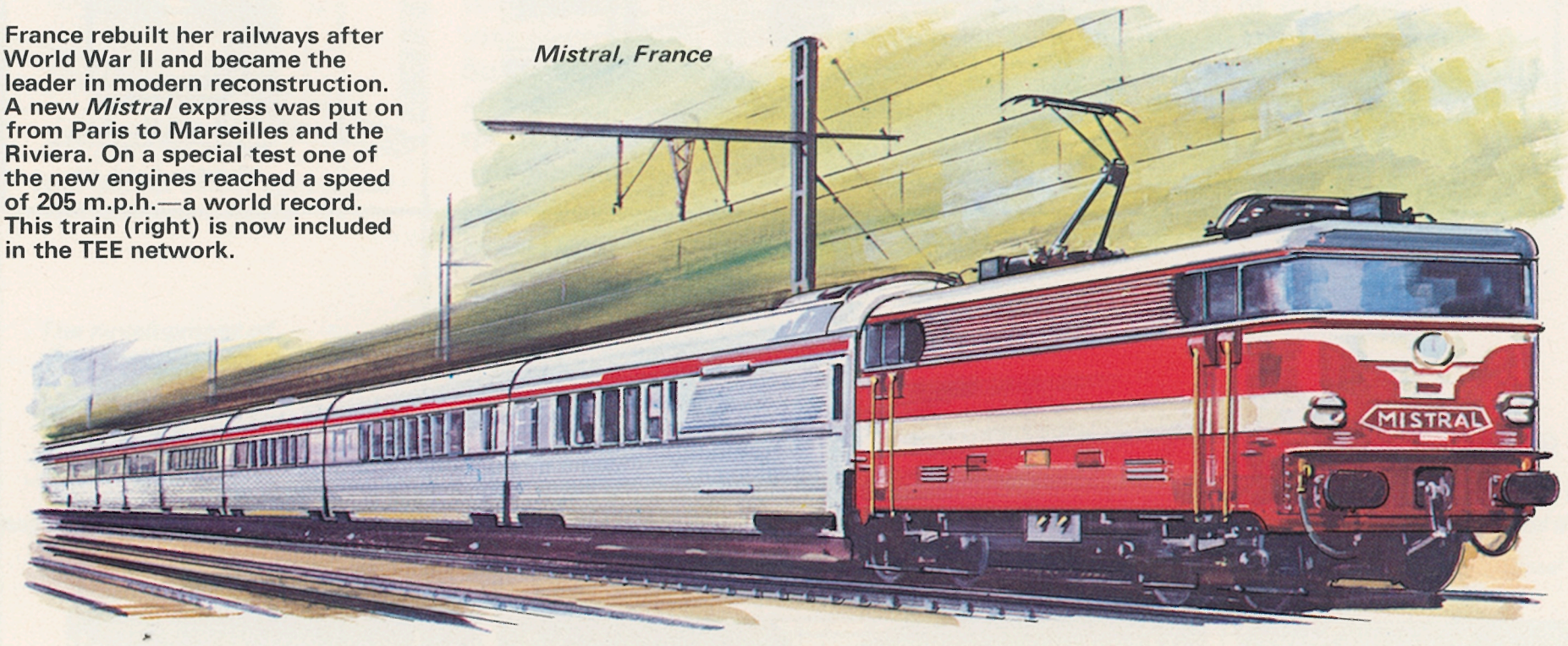
Railway companies are now concentrating on providing efficient high speed services between important centres. In Europe, the Trans-Europe Expresses (TEE) connect capitals and other important centres in every country on the western continent.

Regular fast goods services are provided by liner trains. They transport raw materials and finished goods such as motor cars. Container trains carry giant packing cases which can be transferred intact onto lorries or ships, which saves handling time.

In general, freight traffic has been speeded-up so that it often runs as fast as passenger traffic. In addition to providing a better service, this also makes better use of track.

France rebuilt her railways after World War II and became the leader in modern reconstruction. A new *Mistral* express was put on from Paris to Marseilles and the Riviera. On a special test one of the new engines reached a speed of 205 m.p.h.—a world record. This train (right) is now included in the TEE network.

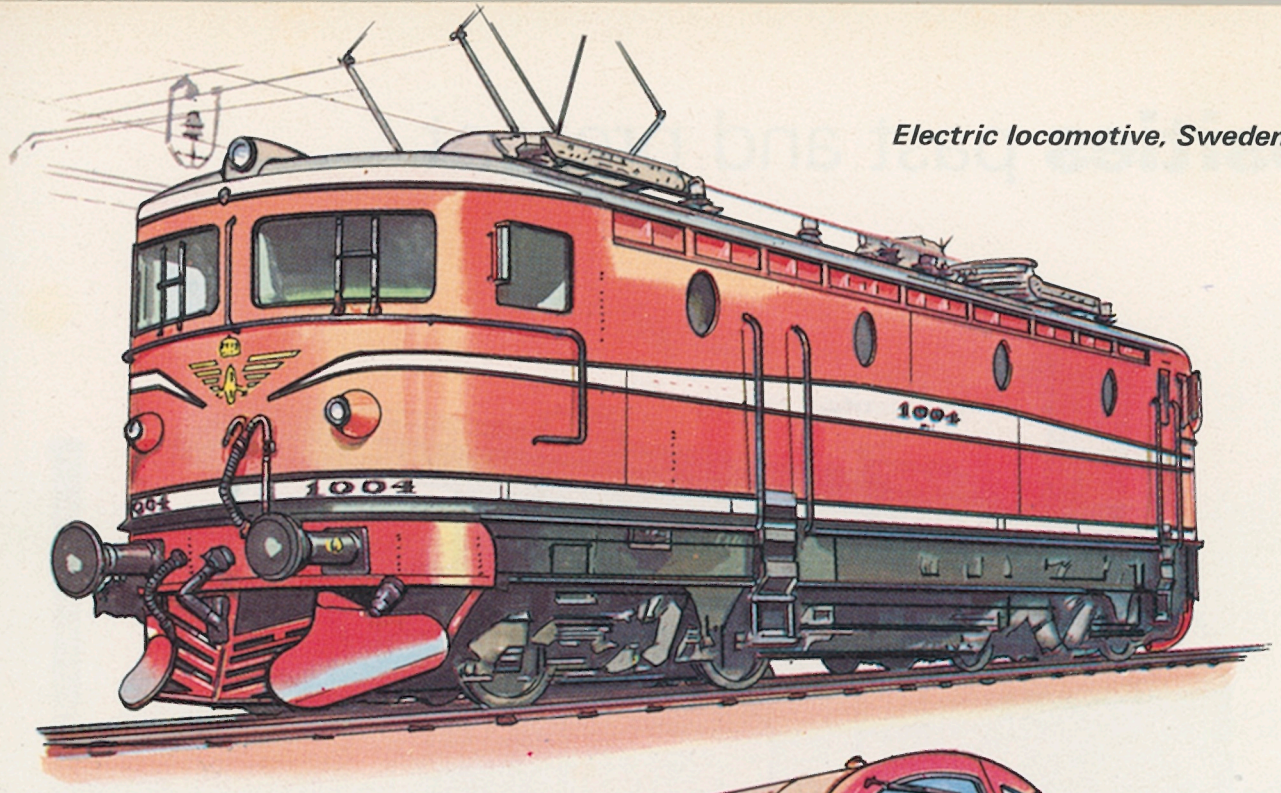
Mistral, France



One of Europe's most comfortable trains is the *Rembrandt* (right) which runs from Amsterdam to Munich. The engine can develop 11,046 h.p. The train is superbly fitted out. It is possible for passengers to telephone any part of the world.

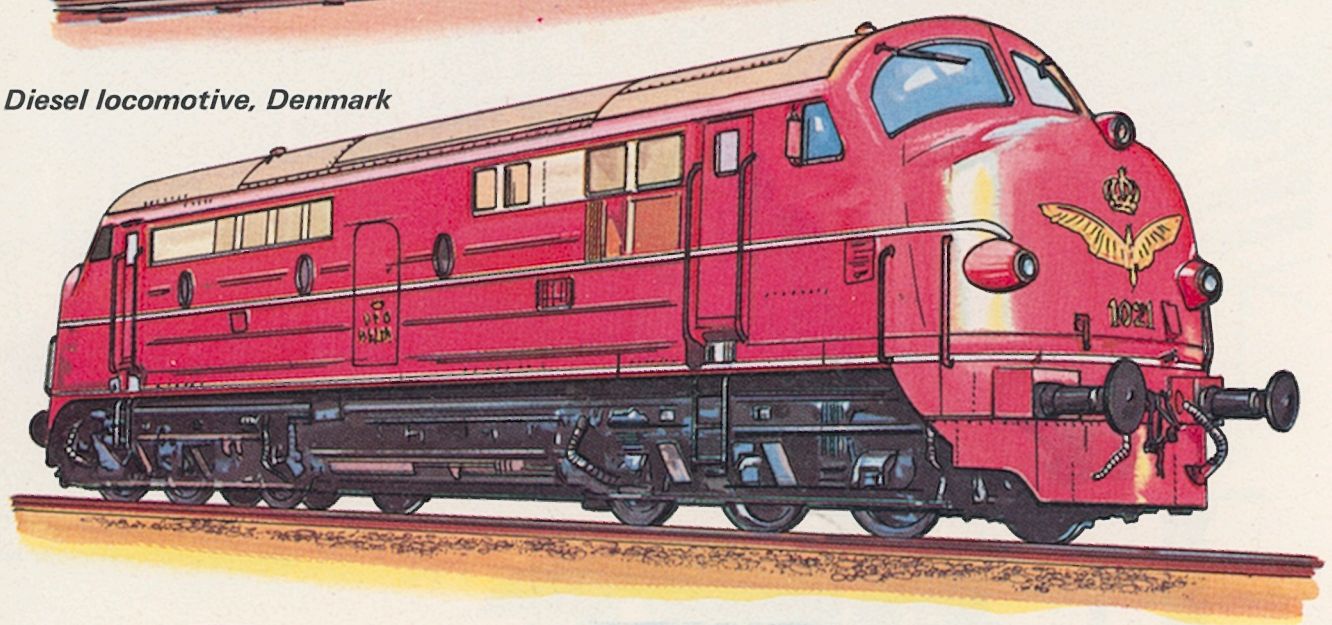
The Rembrandt, Germany

Electric locomotive, Sweden



In Sweden many of the lines are electrified. The engine (left) has high power but is light in weight. Swedish railways connect with West Germany and Denmark by train ferries.

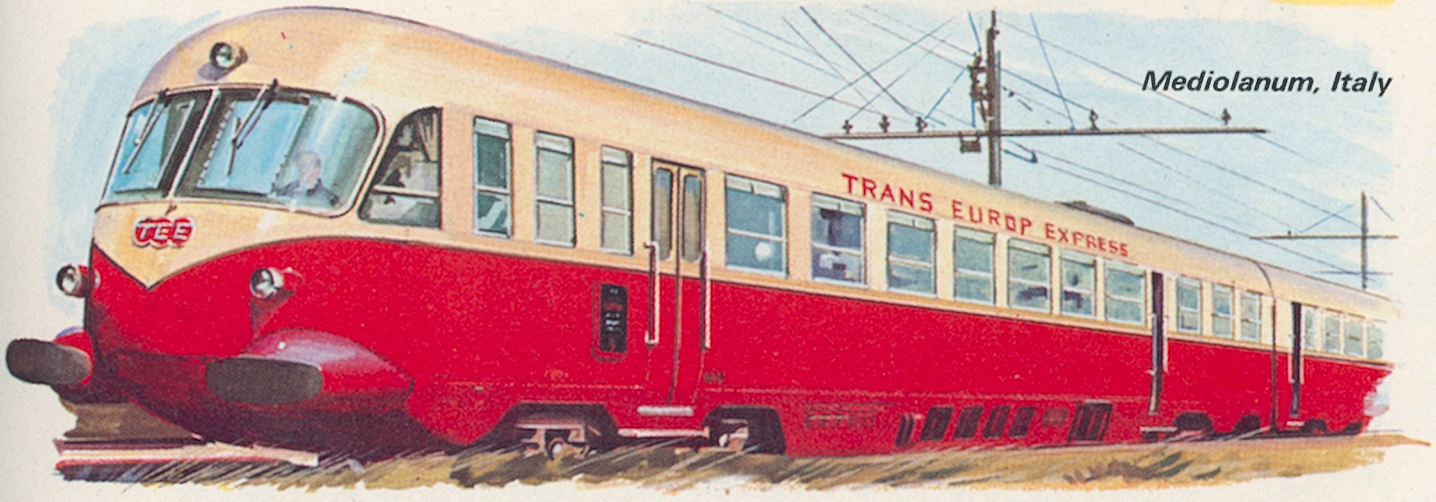
Diesel locomotive, Denmark



A modern diesel-electric engine (left) built in Sweden for the Danish State Railways.

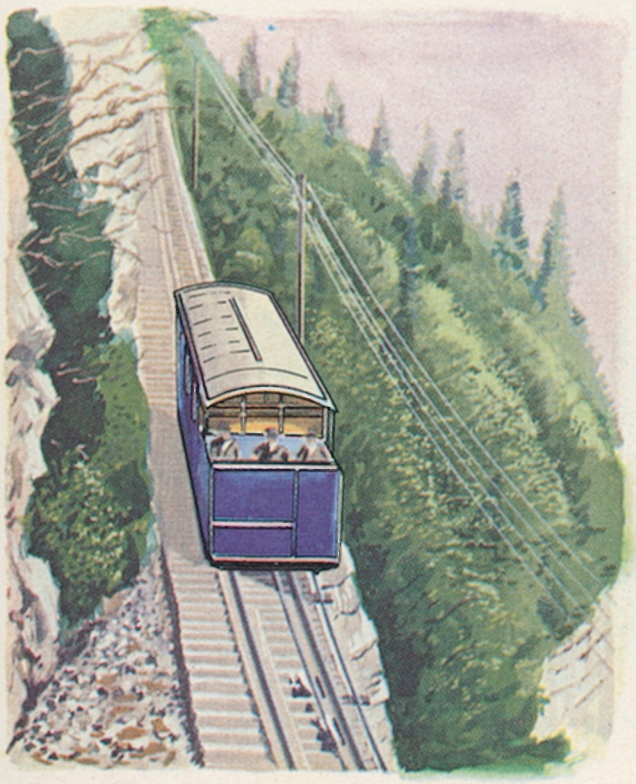
There are many islands in Denmark. The larger ones are connected by train ferry services.

Mediolanum, Italy



Another high speed train of the TEE network is the Italian *Mediolanum* (left) which runs from Milan to Munich. The 357 miles take about seven hours. This is a good run because there is a fairly steep climb over the Brenner Pass between Italy and Austria.

Nielsen cable railway, Switzerland



Aerial cableway, France

The Neilsen Railway (far left) in Switzerland climbs about 5,400 ft. It is one of the steep narrow gauge "funicular" lines on which the cabins are moved by a cable between the rails.

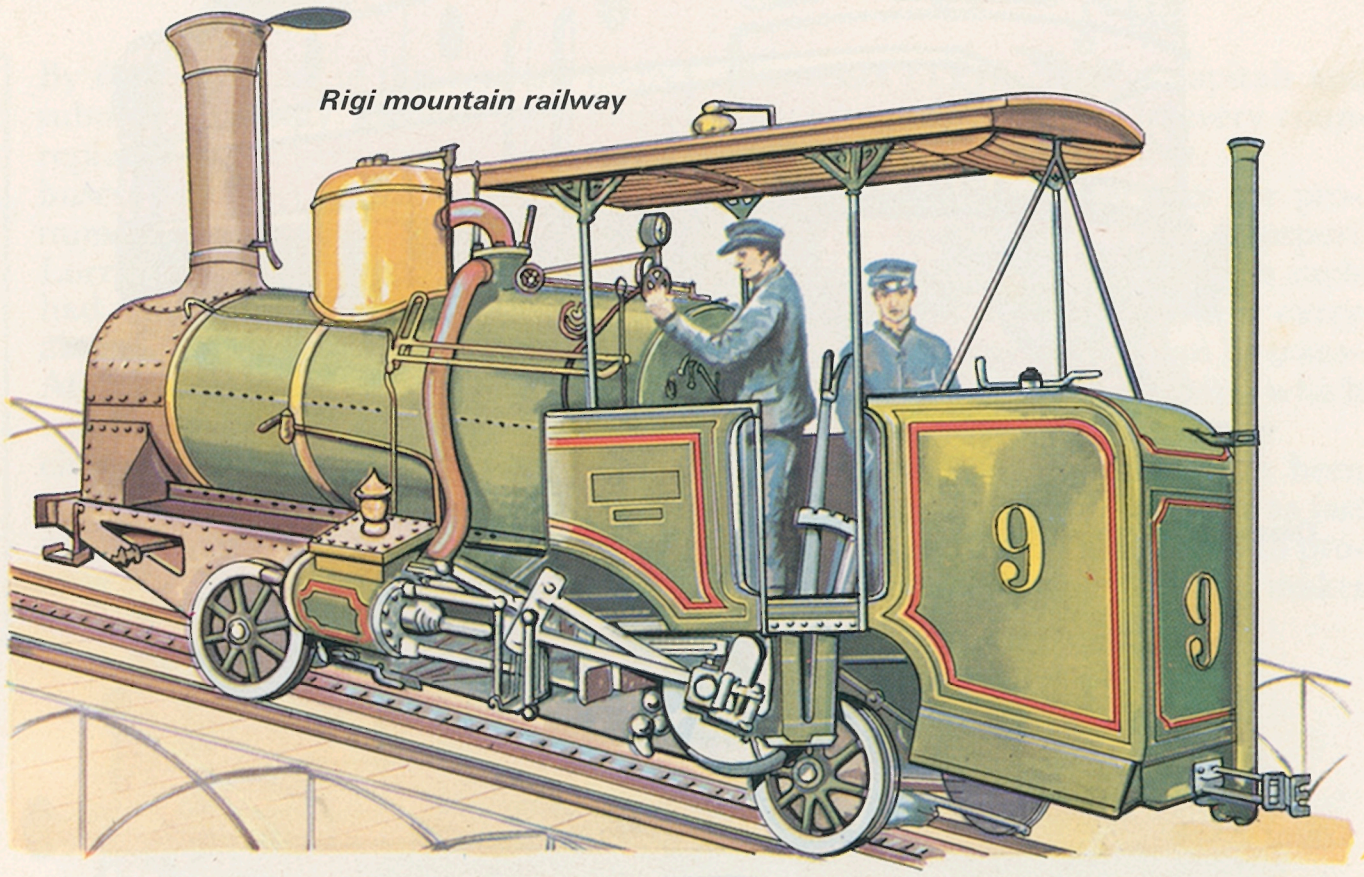
Aerial cableways are popular with tourists. They have been built in mountainous regions to bridge chasms and scale vertical heights. A cable car in the Mont Blanc area (left) crosses a 4,480 ft. gap, suspended 1,000 ft. above the ground.

Railway curiosities past and present

Most mountain railways are too steep to work by normal adhesion —the wheels would not grip the rails. So a cable, or rack and pinion, is used to assist in haulage. On the Rigi mountain railway (right) in Switzerland, a strong toothed rack is laid between the rails. An engaging cog wheel, or pinion, is fitted under the engine to help in pulling or braking.

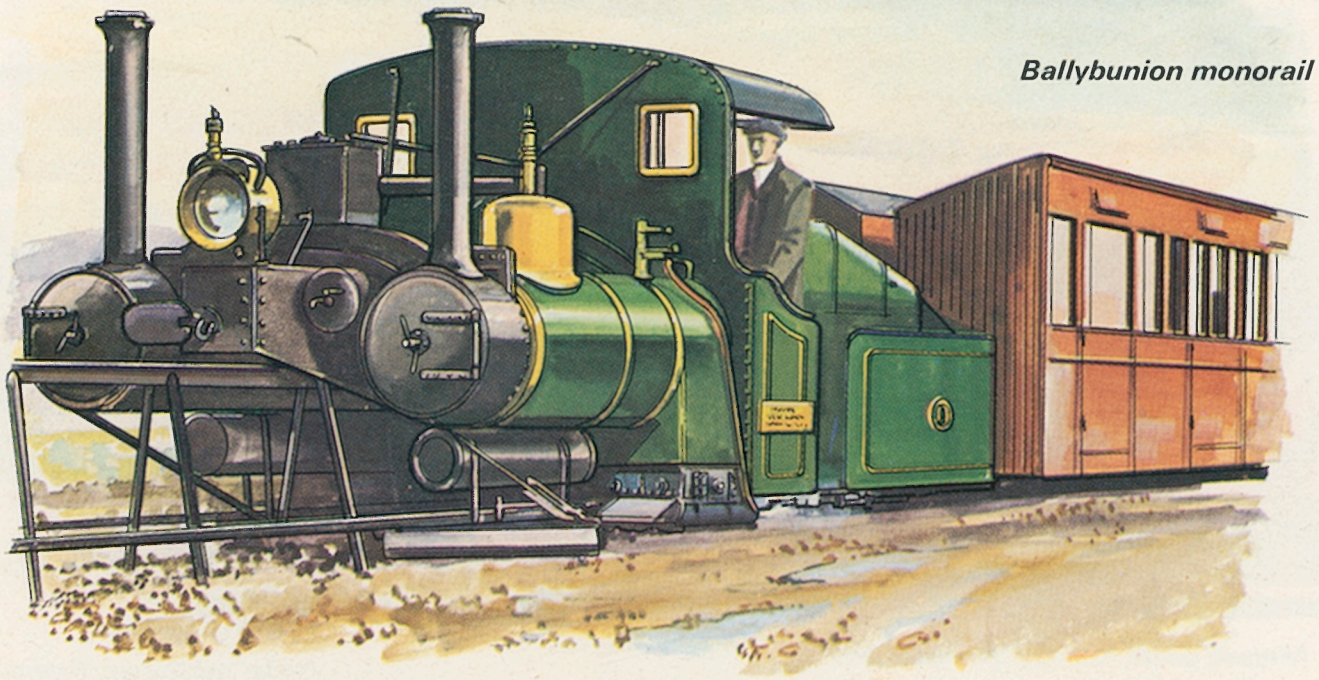
The picture shows one of the original steam engines on the Rigibahn: some of these can still be used, though there are now two lines up the Rigi, both electrified. A similar railway on Snowdon is still worked by steam, however.

Rigi mountain railway



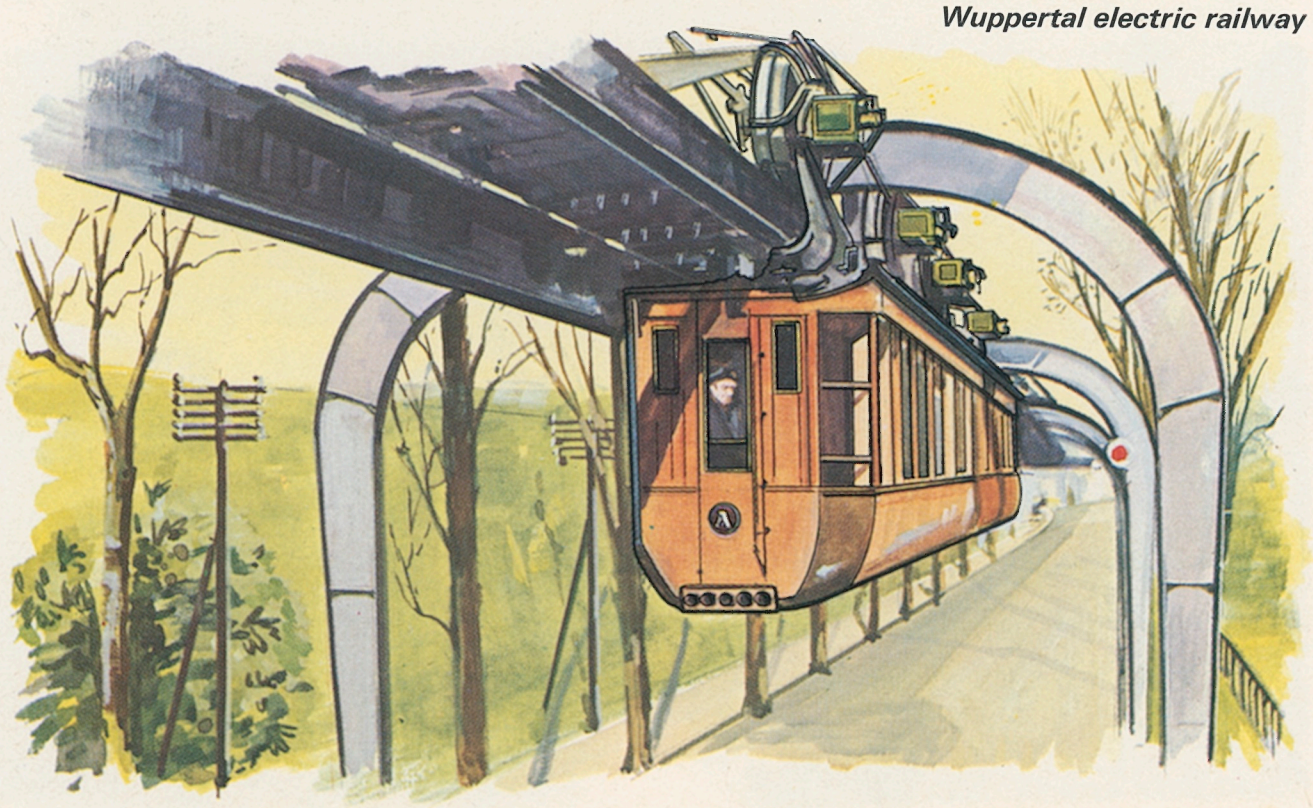
The Listowel and Ballybunion line in Ireland was called a monorail but it was really a trestled line. There was a carrying rail at the top, and lower lines for steadying on each side. The trains (right) were, like the locomotives themselves, split in half with the rail between. This experiment did not last long.

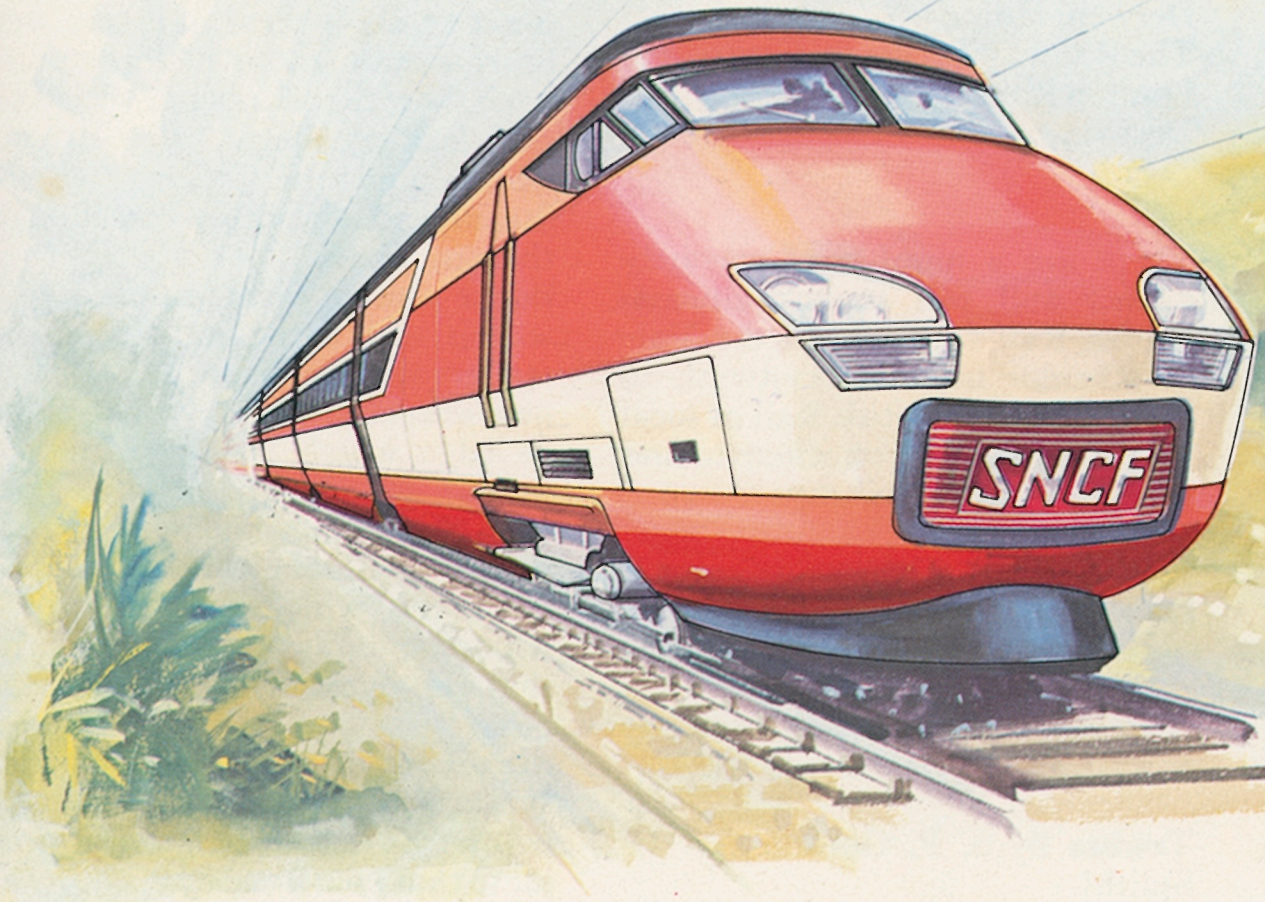
Ballybunion monorail



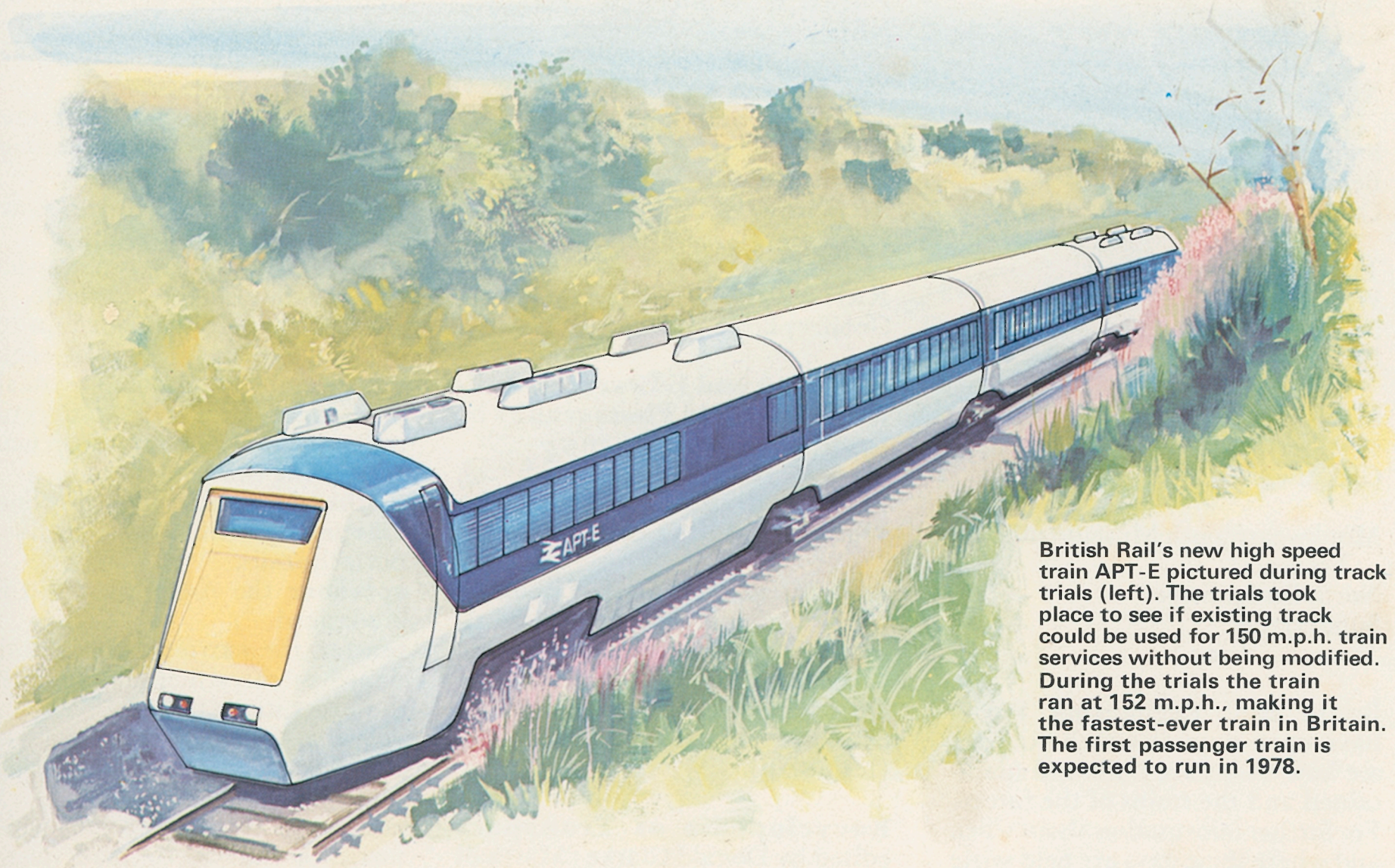
One monorail system which has lasted is the electrified Wuppertal railway which straddles a valley in the industrial area of N-W Germany. Unconventional as it is, it plays an important part in the city's transport system.

Wuppertal electric railway





French National Railways' prototype gas turbine electric train TGV 001 (left). This train was built in 1972 and has a designed maximum speed of 185 m.p.h. While on trial on a straight stretch of line south of Bordeaux, it reached a speed of 190.5 m.p.h.



British Rail's new high speed train APT-E pictured during track trials (left). The trials took place to see if existing track could be used for 150 m.p.h. train services without being modified. During the trials the train ran at 152 m.p.h., making it the fastest-ever train in Britain. The first passenger train is expected to run in 1978.

Things to do

Places to visit

National Railway Museum
Leaman Road
York

Great Western Railway Museum
Faringdon Road
Swindon
Wiltshire

Narrow Gauge Railway Museum
Tywyn
Gwynedd

Festiniog Railway Museum
Harbour Station
Porthmadog
Gwynedd

London Transport Collection
Syon Park
Brentford
Middlesex

Pendon Museum of Miniature Landscape and Transport
Abingdon
Oxfordshire

North of England Open Air Museum
Stanley
Beamish
Co. Durham

Transport Museum
Witham Street
Newtownards Road
Belfast

Museum of Transport
25 Albert Drive
Glasgow 41

Monkwearmouth Museum of Land Transport
North Bridge Street
Sunderland
Tyne and Wear

British Rail Engineering Works have open days at which you can see how trains are built and maintained and the trains of the future. For further information about when and where these days are held write to:

Mr Bernard Ault
Publicity Officer
Room 103
Derwent House
The Railway Technical Centre
London Road
Derby.

There are a number of privately owned and run steam railways. British Rail runs one in the Vale of Rheidol from Aberystwyth to Devil's Bridge. British Rail or local museums will tell you where to find the nearest steam railway.

Books to read

A History of Railways edited by E. L. Cornwell (Hamlyn/NEL).

Trains by S. P. Gordon (W. H. Smith).

The World of Trains edited by Patrick B. Whitehouse (Hamlyn/NEL).

The Golden Age of Steam by O. S. Nock (A. and C. Black).

Great Steam Locomotives of All Time by O. S. Nock (Blandford).

Railways for Pleasure by Geoffrey Body (David and Charles).

Victorian and Edwardian Railways from Old Photographs by Jeoffrey Spence (Batsford).

Blandford **'Railways of the World'** series by O. S. Nock.

British Rail Diesel Locomotives; British Rail Diesel Multiple Units; British Rail Electric Locomotives and Multiple Units have the numbers and details of all the trains run by British Rail (Ian Allan).

Encyclopedia of Transport edited by Donald Clarke (Marshall Cavendish).

Glossary

2-2-2 or **0-4-4** these numbers, and other combinations of three numbers, show the number of wheels on the leading bogie, the driving wheels and the trailing wheels. Steam locomotives are classified by these numbers.
bogie a small pivoted unit of four wheels, used at the front of engines, tenders and carriages.
cog wheel a wheel with teeth on its edge which usually catches a similar wheel. This combination can transmit movement.
coupled wheels wheels connected by a rod which move together. 'Coupled' is also used for carriages that are joined or attached to each other.
diesel one of the types of engine to succeed steam engines. It is a type of internal combustion engine similar to that used in a car.
double track two tracks along the same route, one for each direction. Many early tracks were single with passing loops at intervals.
gauge the distance between the rails on a track.
loading gauge the maximum height and width of a train through, for example, tunnels.
marshalling the rearrangement of the carriages of a train.
monorail a railway system which uses only one rail instead of two.
piston the circular disc in the cylinder which in a steam engine was driven up and down by steam. The piston drove the connecting rods and cranks which in turn made the driving wheels go round.
railhead the end of a railway line.
sleeper a piece of wood which supports the rails.
splasher the American word for mudguard.
tender the carriage specially designed to carry fuel and water for the larger steam trains.
valve a hinge which controls the flow of water, fuel or steam through a pipe.
viaduct a bridge with arches which carries a railway or road over a valley or river.

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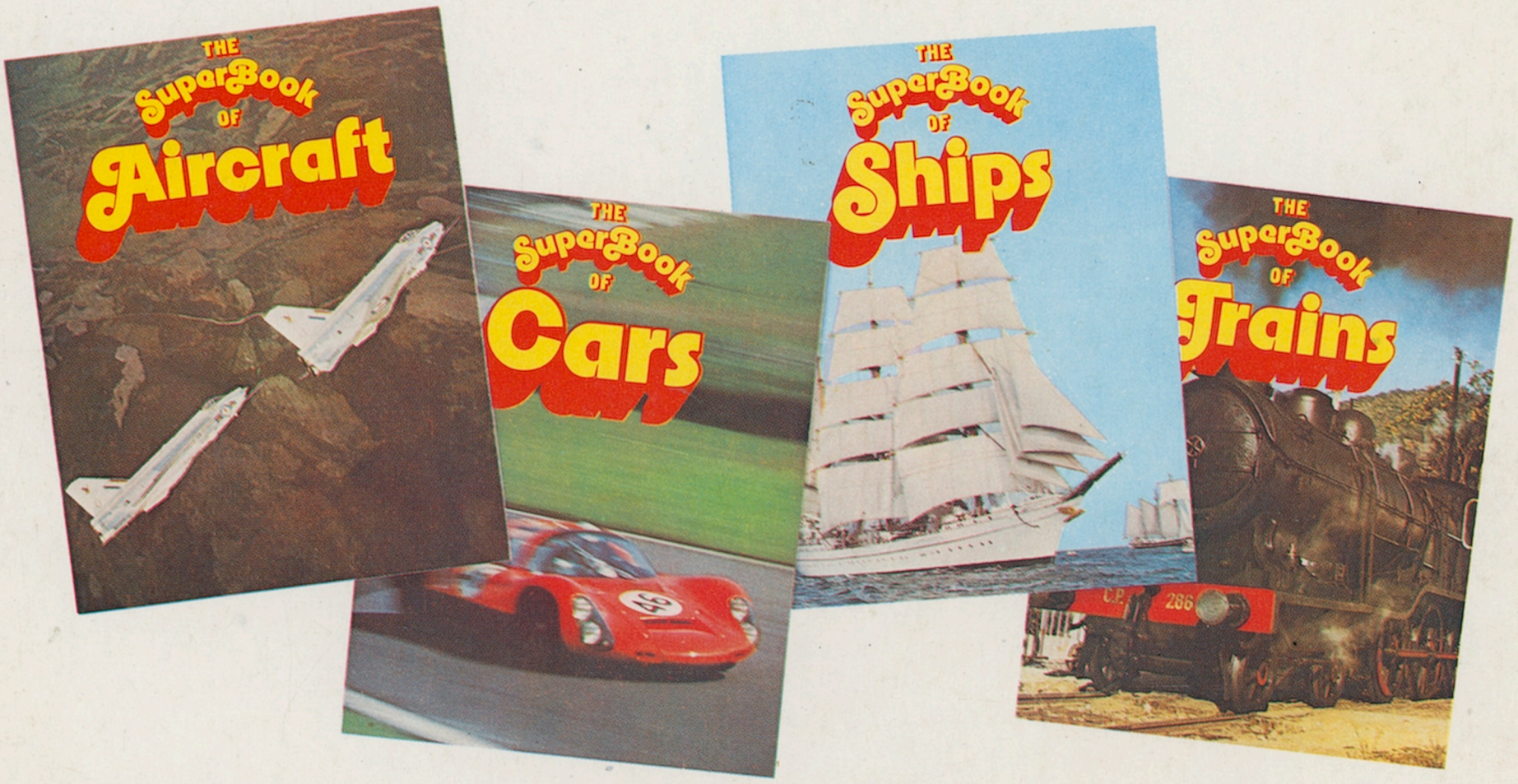

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